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THE
COAL-FIELDS
OF
NOVA SCOTIA.

By JOHN RUTHERFORD, M.E.,

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УВАЖАЮЩИЕ ЧЛЕНАТА

THE
COAL-FIELDS OF NOVA SCOTIA.

THE mineral resources of the province of Nova Scotia have only of late years received that attention to which their extent and value certainly entitle them. Whether as regards the more recent development of a large tract of auriferous rocks, or the older and rapidly extending operations in coal, there are few countries that offer greater scope for mining enterprise, or are more likely to reward, and that liberally, the judicious capitalist.

The geological features of the province are interesting and peculiar. On the southern shores a range of metamorphic rocks, of the usual apparently barren aspect, extends the entire length of the province, and is spread inland a width varying from fifteen to thirty miles; while on the northern shore, including the island of Cape Breton, the carboniferous formation prevails to a greater or less extent, almost from its eastern to its western limit. Having, in 1865, been honoured with the appointment of Provincial Government Inspector of Mines, the writer has, in the exercise of his duties, become acquainted with all the districts in which mining has been carried on, and purposes in the following pages to give a brief description of the different coal-fields that have been opened, with such particulars respecting them, and of the coal trade generally, as will, it is hoped, be considered a not unacceptable addition to the knowledge of "our coal-fields." It may be remarked, at the outset, that although the existence of large deposits of coal in different parts of the country was not unknown, it was not until a change in the tenure, occasioned by the transfer of the mineral rights from the Imperial to the Provincial Government, that a knowledge of the wealth of the province in this particular mineral became general. For many years the General Mining Association of London were sole possessors of the mineral rights. It would be foreign to the subject of this paper to state how so valuable an acquisition was obtained; the story is associated with the days of "the Georges," which happily will not bear comparison as respects regal

every-day life with the Victorian period, in which it is our good fortune to live.

On the cessation of the monopoly, by agreement, in 1857, certain tracts were reserved by the Association, and the remainder was vested in the Crown for the benefit of the province. These reserved tracts or mining areas vary in extent from two to about twenty square miles, and are situated in different localities; they are subject to the same royalty, and are held in nearly all respects in the same manner as others subsequently granted. As soon as this arrangement was completed, a code of laws was framed for regulating the letting and working of the mines, and the various districts were thrown open to the public. Licenses to search for minerals were eagerly taken out, and explorations were so vigorously prosecuted that there are now upwards of thirty collieries in addition to those of the General Mining Association; and the yield of coal has risen from 267,496 tons in 1869 to 566,779, the average of the last four years.

As may be expected with so recent a development of the mineral resources of the province, much has yet to be done to prove the extent and shape of the different coal-fields. The accompanying map of Nova Scotia and Cape Breton conveys, therefore, but an idea of their relative position. According to the present knowledge of them, they appear to be nine in number; it is probable, however, that future explorations will reduce the number by proving a connection and showing that their apparent isolation is attributable to denudation and the usual wasting of sea margins.

Although there are several tracts of carboniferous formation in various parts of the country (see Plate I.), it is remarkable that the largest and most valuable are situated near and along the northern shores of Nova Scotia, and over a considerable portion of the northern and eastern shores of Cape Breton. The geological structure of the province, as ascertained by the invaluable labours of Dr. Dawson, a native and an eminent geologist, sufficiently accounts for the apparent peculiarity. The southern coast, as has been stated, consists of Silurian rocks, the bare and rugged aspect of which, with their deep indentations forming magnificent land-locked harbours, is in striking contrast with the gently undulating and cultivated hills and dales which usually characterize the more recent and valuable deposit. The most westerly situated of the coal-fields is in the county of Cumberland (see Plate II.), the South Joggins shore of which has obtained a well deserved geological fame. In the cliffs of this shore there is exhibited an

extended section of carboniferous strata which is perhaps unequalled; it has been examined by Sir Charles Lyell and other eminent geologists, and the members of it have been carefully measured by Sir William Logan. For a distance of nearly ten miles along the shore, bed after bed is exposed, to an aggregate thickness of upwards of 14,000 feet. In an economic point of view, however, the section is not of that importance which the thickness of the measures might be supposed to imply; for although there are over seventy beds of coal, there are only three of a workable size. Two of these are worked at the Joggins Colliery which is situated near the shore and on one of the tracts held by the General Mining Association. The following section of that portion of the measures in which these seams are found will convey an idea of the character of the stratification and show the relative position of the seams. The dip of the strata is to the S.W. at an angle of 19° .

| | Ft. | In. |
|--|-----|-----|
| Grey and black shales | 1 | 4 |
| Coal | 0 | 8 |
| Under clay | 3 | 9 |
| Sandstone and shale | 12 | 6 |
| Under clay | 1 | 6 |
| Coal | 0 | 1 |
| Sandstone and shale | 15 | 0 |
| Ditto, grey | 7 | 0 |
| Grey shale | 4 | 0 |
| Grey sandstone | 4 | 0 |
| Grey shale | 0 | 6 |
| Coal } Main, or King's seam | 3 | 6 |
| Shale } | 1 | 6 |
| Coal } | 1 | 6 |
| Under clay, sandstone, and shale | 27 | 6 |
| Grey shale | 4 | 0 |
| Grey sandstone | 2 | 0 |
| Grey shale | 6 | 6 |
| Coal | 0 | 0½ |
| Grey shale | 0 | 11½ |
| Coal and shale | 0 | 0½ |
| Sandstone and shale, with ironstone bands | 17 | 9 |
| Coal | 0 | 1 |
| Sandstone and shale | 16 | 4 |
| Coal | 0 | 3 |
| Under clay | 0 | 5 |
| Coal—Queen's seam | 1 | 9 |
| Shale | 4 | 4 |
| Coal | 1 | 0 |

| | | | | | | | | Ft. | In. |
|---------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Under clay and shale | ... | ... | ... | ... | ... | ... | ... | 4 | 0 |
| Coal (Hard Scrabble) seam | ... | ... | ... | ... | ... | ... | ... | 4 | 0 |
| Under clay | ... | ... | ... | ... | ... | ... | ... | 1 | 6 |

The beds are found in nearly a horizontal position on proceeding southwards, and there are indications of a rise in that direction. At Apple River, distant S.W. from the Joggins Mine about 25 miles, the formation rests against a range of Silurian rock, which, extending in an east and west direction, forms the Cobequid Mountains. A small seam of coal is said to have been found in this locality, but at present no mining operations are carried on: as that portion of the strata in which the workable seams are found does not, according to Dr. Dawson, appear on the southern side of the trough, it is probable that they are at a considerable depth from the surface; a supposition which recent explorations tend to confirm. On the northern crop of the seams several mines have been opened; the measures are, however, much disturbed by faults, and the seams are so altered in size and quality, that identification is extremely difficult. At the Victoria Colliery, for example, which is situated three miles to the east of the Joggins, there are three distinct seams, the upper of which is 1 foot 10 inches, the middle seam 3 feet, and the lower one 5 feet $1\frac{3}{4}$ inches in thickness. Between the upper and the middle seam there is a thickness of strata of 15 feet, and between the middle and lower about 50 feet. The lower seam is of the following section:—

| | | | | | | | | | Ft. | In. |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|----------------|
| Coal | ... | ... | ... | ... | ... | ... | ... | ... | 0 | 6 |
| Shale | ... | ... | ... | ... | ... | ... | ... | ... | 1 | 4 |
| Coal | ... | ... | ... | ... | ... | ... | ... | ... | 1 | 2 |
| Shale | ... | ... | ... | ... | ... | ... | ... | ... | 0 | $9\frac{1}{4}$ |
| Coal | ... | ... | ... | ... | ... | ... | ... | ... | 1 | 4 |
| | | | | | | | | | 5 | $1\frac{1}{4}$ |

About a mile further east, two seams, each 2 feet 6 inches thick, including some bands of carbonaceous shale, have been worked at the Lawrence Colliery. These seams are 20 feet apart, and at the adjoining Colliery, Macan, distant $4\frac{1}{2}$ miles, there are three seams, two of which only are workable, the lower being 4 feet thick, inclusive of 1 foot 10 inches of shale, and the upper 2 feet 4 inches. The thickness of the strata between these two seams is here 400 feet, the other seam being 100 feet below the upper one and 20 inches thick.

Still further east, at the St. George and Chiegnecto Collieries, a seam, or rather an aggregation of seams, is worked, which is entirely

different in every respect from those last named, so much so indeed that it may be questioned whether it is the representative of them or not. The following are sections taken at these collieries:—

| CHIEGNECTO. | | | | ST. GEORGE. | | | |
|-------------------------|-----|-----|-----|-------------|-----|-----|-----|
| 750 feet east of shaft. | | | | | | | |
| | | Ft. | In. | | | Ft. | In. |
| Coal (coarse) ... | ... | 2 | 6 | Coal ... | ... | 3 | 6 |
| Shale ... | — | 0 | 10 | Shale ... | ... | 2 | 0 |
| Coal ... | ... | 3 | 6 | Coal ... | ... | 3 | 10 |
| Shale ... | ... | 1 | 3 | Shale ... | ... | 1 | 10 |
| Coal ... | ... | 5 | 0 | Coal ... | ... | 0 | 11 |
| <hr/> | | | | <hr/> | | | |
| 13 1 | | | | 12 1 | | | |

So marked a difference in the size and composition of the seams would almost induce a belief that they are distinct beds of coal, the true position of which has not yet been ascertained. That great disturbances have occurred is evident, not only from the number of faults, but also from the difference in the declination of the seams. The former of these peculiarities is strikingly illustrated at the Victoria Mine. At this colliery a downthrow to the west was met with a short distance west of the foot of the slope; 70 feet further west an upthrow of 55 feet was passed through, and about 50 feet still further west another upthrow of the same size again interrupted the workings. Proceeding westward, 280 feet, they were again cut off by another upthrow of about 60 feet, and at a further distance of 80 feet they were once more thrown off by a similar sized fault. In a distance of 1,600 feet one half of the drifting was in stone.

Between the Lawrence and the Macan Collieries there appears to be some serious interruption to the continuance of the seams, as they have not been found in the adjoining property on the west of the latter mine.

The declination of the seams at their crop increases on proceeding eastward from the Victoria Mine as far as the St. George. At the Joggins they dip south-east at an angle of 19°; at the Victoria, nearly south, 17°; at Lawrence 22°; Macan 35°; Chiegnecto 42°; and at St. George 46°.

The most easterly situated opening on these seams is the Styles Mine, which is distant from the St. George about five miles, and from the Joggins 14 miles. The seam at this mine is 7 feet 8 inches thick, with a band of carbonaceous shale in the middle 6 inches thick; it dips to the south-west at an angle of 40°.

Whatever may be the relation of these seams to each other, it is evident that whether they are the same beds of coal that appear on the

Joggins shore, altered in position by the increase or decrease in thickness of the intervening shales and of the coal itself; or whether they are distinct seams, they unmistakably indicate the course of the northern side of this coal-field. Eastward from Styles Mine the strike of the measures has been traced a short distance with little variation in their course, but whether they continue in it much further, or they trend to the south, and then westward, and thus form the eastern end of the basin, has not yet been ascertained. The latter supposition has its origin in the fact of a counter-dip of the strata being found on a branch of the Black River, about five miles to the south of Styles Mine. It does not certainly follow from this knowledge alone that such will be the case; the strike on each side may, on the contrary, diverge northward and southward, but there seems to be little doubt that the reverse position of the strata represents the opposite or southern side of the coal-field. From this point on the Black River the strata have been traced to the south-west upwards of four miles, through what is known as the Springhill district, in which locality seams of coal have been discovered, varying from 2 feet to $13\frac{1}{2}$ feet in thickness. The General Mining Association have here an area of 2560 acres, near the southern boundary of which is the crop of a very fine seam; it is of the following section:—

| | | | | | | | | | Ft. | In. |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-------|-----|
| Coal | ... | ... | ... | ... | ... | ... | ... | ... | 1 | 6 |
| Shale | ... | ... | ... | ... | ... | ... | ... | ... | 1 | 0 |
| Coal | ... | ... | ... | ... | ... | ... | ... | ... | 11 | 0 |
| | | | | | | | | | <hr/> | |
| | | | | | | | | | 13 | 6 |

The seam dips to the north-west at an angle of 25° . It is underlaid at a depth of about 350 feet by one 11 feet 3 inches thick, the quality of which is also of a high class. South of the crop of this last the crops of three others, varying in thickness from $2\frac{1}{2}$ to 4 feet, have been found, the position of which is conformable with the larger seams.

Between Springhill and Apple River little is known of the position of the measures, and the connection of these two points, in order to complete the circuit of this portion of the Cumberland coal-field, has yet to be made. The difficulty of exploration, and the comparatively recent period within which any explorations could be made, together with the absence of the means of conveyance of the produce of the mines to the seaboard, and the consequent large expenditure that would be required to construct private railways to mines so distant therefrom, have retarded the development of this coal-field, and much, therefore, remains to be accomplished before its extent can even be conjectured. The operations

STYLES.

| | | | | | | | |
|-----------------|-----|-----|-----|-----|-----|-----|-------|
| Volatile matter | ... | ... | ... | ... | ... | ... | 31.30 |
| Coke | ... | ... | ... | ... | ... | ... | 61.14 |
| Ash | ... | ... | ... | ... | ... | ... | 7.56 |

100.00

SPRINGHILL.

| | | | | | | | |
|-----------------|-----|-----|-----|--------------------|-----|--------------------|-----|
| Volatile matter | ... | ... | ... | 13 Ft. 6 In. Seam. | ... | 11 Ft. 3 In. Seam. | ... |
| | | | | 25.38 | ... | 35.39 | ... |
| Fixed carbon | ... | ... | ... | 60.95 | ... | 60.46 | ... |
| Ash | ... | ... | — | 13.67 | ... | 4.15 | ... |

100.

100.00

| | | | | | |
|--------------------------------|-----|-----|-----|-----|-------|
| Theoretical evaporative power* | ... | ... | ... | ... | 8.37 |
| Coke | ... | ... | ... | ... | 64.60 |
| Sulphur† | ... | ... | ... | ... | 0.225 |

For the reasons already given the mines that have been chiefly worked are situated in positions that do not require expensive lines of railway to connect them with the shipping places. The coal from the main seam, at the Joggins Colliery, is raised up a shaft distant from the shore about 300 yards, and connected with it by a railway. The wagons are run down from the top of the cliff to piers constructed of wood, which are built out into the sea, and arranged so as to form a harbour, inside of which the vessels are loaded. The hard scrabble seam is entered by an adit in the cliff, and the coal is taken direct from the mine into a covered shed, out of which it is removed at a lower level, and carried along a wharf to the ships. This is but a temporary arrangement, but it is a very usual one on first opening mines similarly situated.

The produce of the Victoria and Lawrence Mines is shipped on the River Hebert; and that of the Macan, Chiegnecto, St. George, New York, and Acadia on the Macan river.

The navigation of these rivers is of a peculiar character; they resemble large mud creeks, with deep sloping sides covered with slime, the result of the extraordinary rise and fall of the tide, 40 feet, for which the Bay of Fundy is remarkable. Vessels carrying from 150 to 250 tons are brought by the tide up the river, the course of which is rather tortuous, and on its retirement they are so fixed in the mud that they can receive their cargo without injury. When this is accomplished they float down again with the tide until there is sea room in which to pursue the ordinary course of navigation.

The principal market for the coal at present is St. John's, and a few other places along the New Brunswick coast.

* Professor How.

† E. Hartley, Geological Survey of Canada.

The mines are chiefly owned by American companies, who have not, however, been able to send much of their produce to the States, in consequence of the heavy import duty on Nova Scotia coal. The price on board will average 2 dollars, or 8s. sterling per ton. Freight to Boston 7s. to 8s., and to St. John's 4s. per ton.

The system of working generally followed is on the ordinary bord and pillar principle. The usual practice is to drive a slope from the crop, either direct to the dip or in a transverse direction; from the slope a pair of levels are turned on each side, and the boards are won out of them and driven sometimes to the rise, and sometimes parallel to the levels. When the dip is suitable, the coal is put down shoots or boxes, out of which it is emptied into tubs and taken to the slope or shaft as the case may be. The chief obstacle to a more extensive development of the Cumberland Coal-field, *i.e.*, the want of railway accommodation, is about to be removed. It is fortunate for the coal interest in this county, that the route which nature has to a great extent dictated as the best for the Intercolonial Railway, passes almost through the centre of the coal-field. Skirting the Springhill district, within two miles of the crop of the seams, it takes a course towards Macan River, and thence to Amherst, in the neighbourhood of which town there is ample scope for shipping accommodation in the Cumberland basin. It will thus afford easy access to that water to all the mines at present opened on the east side of the Macan river, and will also offer an inducement for exploring the intermediate country between there and Springhill.

The position of this coal-field in relation to the markets of New Brunswick and the States, is a very advantageous one, inasmuch as from their vicinity, as compared with the eastern districts, the cost of transit must always be in its favour. From the Macan Mines, the carriage by rail will not probably exceed 4 or 5 miles to a suitable shipping place, and from Springhill it will be about 15 miles. The last-named district will also, by means of this railway, be connected with the extensive range of iron ore worked at the Acadian Iron Works, which are distant from the mines by rail about 24 miles; and thus these two important branches of industry will be brought into that relation with each other which will essentially contribute to the success of both.

Situated upwards of sixty miles to the east of the Springhill district of the Cumberland coal-field, is the coal-field of Pictou (see Plate III.), which, whether as regards its peculiar configuration or the number and size of the seams, is one of the most extraordinary carboniferous deposits in the world. The General Mining Association have for many years carried on mining operations in this locality, and have

here a very extensive establishment, known as the Albion Mines. Two seams only have been worked to any extent at this colliery, and as they are the "datum line," if the term may be used, for all others, having been the only seams worked for many years, their position will be first described, in order that the relation to them of the subsequent discoveries and openings, may be the more readily understood.

These seams were originally opened on their southern crop, and have a dip to the N.E. of about 20°. The upper seam of these two, which is not, however, the highest in the series, is called the "Main Seam;" and, certainly, if thickness is a qualification for such a title, it well deserves this designation.

The following sections of the strata sunk through in two of the shafts, one of which, the Forster Pit, is situated near the western extremity of the workings, and distant from the other 1100 yards, will best convey an idea of the character not only of the beds in this portion of the coal-field, but also of the two seams, for which it is remarkable.

| SUCCESS ENGINE PIT. | | | FORSTER PIT. | | |
|---------------------|------------------|---------|-----------------------|----------------------------|---------|
| | | Ft. In. | | | Ft. In. |
| Surface clay ... | ... | 8 2 | Clay, yellow ... | ... | 1 6 |
| Shale and bands of | } | 64 10 | " blue ... | ... | 13 6 |
| ironstone ... | | | Post ... | ... | 15 3 |
| Coarse coal ... | Main seam ... | 0 2 | Fire clay ... | ... | 2 6 |
| Good do. ... | | 5 0 | Black shale ... | ... | 0 6 |
| Ironstone ... | | 0 6 | Fire clay ... | ... | 2 6 |
| Good coal ... | | 14 4 | Black shale ... | ... | 22 0 |
| Ironstone ... | | 0 4 | Dark post ... | ... | 9 6 |
| Coarse coal ... | | 7 7 | Shale ... | ... | 3 0 |
| Ironstone ... | | 0 4 | Grey post ... | ... | 22 6 |
| Coarse coal ... | | 3 1 | White do. ... | ... | 1 3 |
| Ironstone ... | | 0 4 | Dark grey do. ... | ... | 36 0 |
| Coarse coal ... | | 2 11 | Black shale ... | ... | 90 0 |
| Ironstone ... | Ft. In. 39 11 | 0 5 | Brown do. ... | ... | 60 0 |
| Coarse coal ... | | 4 11 | Grey post, with iron | } 105 0 | |
| Shale and bands of | } | 157 7 | stone girdles ... | | |
| ironstone ... | | | | | |
| Bad coal ... | Deep seam... | 0 2 | Brown shale ... | ... | 5 0 |
| Good do. ... | | 3 10 | Grey post, with iron- | } 60 0 | |
| Ironstone ... | | 1 2½ | stone bands ... | | |
| Coal ... | | 3 7½ | Coarse coal ... | Main seam Ft. In. 41 | 4 0 |
| Slaty coal ... | | 0 9½ | Black shale ... | | 1 0 |
| Good do. ... | | 4 2 | Good coal ... | | 10 0 |
| Coarse do. ... | | 1 0½ | Fire clay ... | | 3 0 |
| Good do. ... | | 3 8 | Good coal ... | | 23 0 |
| Inferior do. ... | | 6 3 | | | |

A striking peculiarity in these sections is the prevalence of ironstone, not only in the shale but also in the seams, in one of which, the main seam, it is regularly interstratified; the thickness of the shale is also remarkable. This singular deposit appears to increase in thickness towards the centre of the basin; a shaft, recently sunk, having passed through upwards of 800 feet of it. It is very bituminous, with much uniformity of character.

The seams have been extensively worked, but principally in an east and west direction; the lowermost levels being only 600 yards from the crop. The position of this part of the coal-field is, therefore, well ascertained over an extent of line of crop of upwards of a mile and a half. The course of the strike varies at each extremity of the workings. About midway between them it is S. 45° E., at the eastern end it is S. 35° E., and at the western end N. 66° W.

Beneath the deep seam there are others, some of which have been partially worked. The principal of these is the McGregor seam which underlies the deep seam about 47 fathoms. It is of the following section.

| | | | | | | | | |
|---------------|-----|-----|-----|-----|-----|-----|-----|---------|
| Coal (good) | ... | ... | ... | ... | ... | ... | ... | Ft. In. |
| | | | | | | | | 2 6 |
| " " | ... | ... | ... | ... | ... | ... | ... | 3 3 |
| Coal (coarse) | ... | ... | ... | ... | ... | ... | ... | 4 0 |
| Shale | ... | ... | ... | ... | ... | ... | ... | 0 4 |
| Coal (good) | ... | ... | ... | ... | ... | ... | ... | 1 5 |
| | | | | | | | | <hr/> |
| | | | | | | | | 11 6 |

Immediately overlying this seam there is a bed of shale about 6 feet thick, and above it a seam of coal which varies in thickness from 2 feet 6 inches to 4 feet. Between this seam and the deep seam there are two others, the Purvis and the third coal, the thickness of each of which is about 4 feet.

Forty fathoms below the McGregor there is a seam known as the Stellar or oil coal seam. This is a peculiar deposit, and at one time attracted some attention on account of its oil yielding qualities. It was worked for a short time, and would probably have been continued but for the discovery of the oil wells of Canada and the United States. It is of the following composition:—

| | | | | | | |
|--------------------------|-----|-----|-----|-----|-----|---------|
| Inferior bituminous coal | ... | ... | ... | ... | ... | Ft. In. |
| | | | | | | 1 2 |
| Oil coal | ... | ... | ... | ... | ... | 1 8 |
| Bituminous shale | ... | ... | ... | ... | ... | 2 0 |

The thicknesses vary occasionally; the general size is about 5 feet. The central or oil coal portion has yielded upwards of 100 gallons of crude oil per ton.

All these seams are conformable in every respect, and this portion of

the coal-field is, therefore, in a very decided and regular shape. It will be easily understood that with two such colossal and fine seams open, the General Mining Association would have little inducement to prosecute researches for others; and beyond the fact, proved by the extension of their workings, that on the east side of East River and also towards the western end of their property, the main seam from some cause is deteriorated in quality, there seemed to be no reason to anticipate either a limitation of their working capacity for very many years, or the springing up of a competition consequent on the discovery of other seams outside of their extensive area. On the transfer of the mineral rights, however, attention was naturally directed to this district; several mining areas were taken up for exploration, and a large tract of country was speedily occupied under the different powers granted by leases and licenses. The discovery of a remarkably fine bed of coal about two miles to the south-west of the Albion Mines seam was the first result of these explorations, which were subsequently increased in importance by the finding of others underlying it. The position, size, and quality of these seams gave them a character so entirely different from the main and deep seams that their identification with these appeared to be attended with more than ordinary difficulty. The reasonable assumption of a large downthrow fault to the west would partly account for their position, but the change in quality and size was less easily explained. The following is a section of the seam at the Nova Scotia Colliery, where it was first discovered:—

| | | | | | | | | | Ft. In. |
|---------------|-----|-----|-----|-----|-----|-----|-----|-----|---------|
| Coal | ... | ... | ... | ... | ... | ... | ... | ... | 7 0 |
| Fire clay | ... | ... | ... | ... | ... | ... | ... | ... | 0 11 |
| Coal | ... | ... | ... | ... | ... | ... | ... | ... | 3 9 |
| Stony band | ... | ... | ... | ... | ... | ... | ... | ... | 0 2 |
| Coal | ... | ... | ... | ... | ... | ... | ... | ... | 6 0 |
| Do. coarse... | ... | ... | ... | ... | ... | ... | ... | ... | 2 0 |
| | | | | | | | | | <hr/> |
| | | | | | | | | | 19 10 |

It dips at this colliery to the east at an angle of 25°. At the adjoining collieries to the south-east, the dip is rather less, and the section of the seam is also a little different as will be seen in the following:—

| ACADIA. | | | | INTERCOLONIAL. | | | |
|----------------|-----|-----|---------|------------------|-----|-----|---------|
| | | | Ft. In. | | | | Ft. In. |
| Coal | ... | ... | 7 2 | Coal | ... | ... | 0 11 |
| Soft clay band | ... | ... | 0 3 | Shaly do. | ... | ... | 0 1 |
| Coal | ... | ... | 10 4 | Coal | ... | ... | 5 3 |
| Do. coarse | ... | ... | 1 3 | Shaly parting... | ... | ... | 0 4 |
| | | | <hr/> | Coal | ... | ... | 4 0 |
| | | | 19 0 | Do. coarse | ... | ... | 0 2 |
| | | | | Coal | ... | ... | 7 0 |
| | | | | Do. coarse | ... | ... | 2 0 |
| | | | | | | | <hr/> |
| | | | | | | | 19 9 |

Below this seam, 160 feet, is one 13 feet thick; and underlying it at a depth of 85 feet, another 12 feet thick, which is also underlain with the same thickness of strata between them by one 6 feet thick. An examination of the Pictou Coal-field has recently been made under the direction of Sir Wm. E. Logan, the Director of the Geological Survey of Canada, with very important results. So far as this particular locality is concerned it may be stated that Mr. Hartley, of the survey, by whom it was examined, has ascertained the existence of faults of great magnitude, and of other geological peculiarities, which quite account for the isolated position of these seams. Two of these faults are to the west of the Albion Mines; their course is in a north and south direction. One of them is near the western end of the Mining Association's tract, and is a downthrow to the west of probably 1,600 feet, the other is about a mile further west, and is an upthrow in the same direction, but much larger in size.

The beds opened at the Nova Scotia and Acadia Collieries are on the east side of the upthrow fault. The course of their strike is nearly parallel with it; but as the strike trends westwardly in proceeding north or south, the range of the seams is intercepted by the fault, and the breadth of coal, though still large, is of less extent in this locality than was at first supposed. These faults intersect towards the north and the south, others running in nearly an east and west direction, and distant from each other about three miles. The one to the south of the mines is an upthrow to the south of probably not less than 4000 feet; the other, north of the mines, is a downthrow to the south of still greater magnitude. They converge to the eastwards, in the direction of Sutherland river, a short distance to the west of which river they are connected by a S.E. upthrow fault forming the fourth side of the coal-field. The difference in the position of these seams with respect to the Albion Mines series, is supposed, from strong geological indications, to be due to a synclinal shape of the measures in this part of the coal-field. The mines above-named are in this case on the western side of a synclinal, the opposite or eastern side of which does not appear in consequence of the depression and interception by the west downthrow and south side faults. On this assumption the relationship of the two localities is considered to be established notwithstanding the diversities of size and quality, which are certainly very conspicuous.

Discoveries of an equally interesting character have been made in the eastern part of the coal-field. Some seams of coal, on the east side of East River, were opened several years ago. These, from their position, appeared to be overlying seams as regards the main seam of the Albion

Mines. Less interest was probably attached on this account to the subsequent discovery of other seams in this locality, than was excited by the finding of a series of beds of coal, with an aggregate thickness of 37 feet, and separated by shales and fire-clay, varying in thickness from 10 to 20 feet, on the west side of the river, and to the north of the Albion Mines, from which their crop is distant about a mile. These beds dip S. 20° E. at an angle of 65°. The crops of the seams are here in a sharply curved form, trending from the Montreal and Pictou Company's shaft in a northerly direction on each side of it. Their range in this course is, however, terminated a short distance northwards by the large downthrow fault of which mention has been made.

In connection with this fault it may be here stated that on the north side of it there is an immense mass of conglomerate of a peculiar character, which traverses a considerable extent of country in a direction nearly parallel with the fault. North of the conglomerate the measures dip towards Pictou, and contain some seams of coal, but none of any importance have yet been found.

The New Glasgow or eastern section of the Pictou coal-field presents features of an equally peculiar but somewhat more intricate character than those last described. Reference has been made to the seams on the east side of East River. A search for others was as energetically pursued on this side as on the west, and seams were found in various places and positions, which seemed to belong to an entirely different series.

The extension to the east of the workings in the main seam at the Albion Mines, and other circumstances, left no reason to doubt the continuance of the seam in that direction, and one of the earliest openings on the east side of the river was, therefore, made in that seam by the Pictou Mining Co. The coal, however, was found to be very inferior in quality; and a continuance of the deterioration having been ascertained by a shaft sunk further to the east, the operations were brought to a close and no further development in this particular locality has yet been made. There is reason to believe, however, that the inferiority in the quality of the coal may be confined to the edge of the crop, and may not extend far to the dip.

Immediately behind New Glasgow in a south-east direction two seams have been opened. One of these, the lowest in the order of stratification is known as the Stewart seam, and is upwards of 3 feet thick. It is overlaid by the Richardson seam, the thickness of which is 2 feet 9 inches. They dip to the south-east at an angle of 20°. The strike trends

| | | | | | | | | | Ft. | In. |
|----------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Under clay | ... | ... | ... | ... | ... | ... | ... | ... | 5 | 0 |
| Post | ... | ... | ... | ... | ... | ... | ... | ... | 4 | 6 |
| Shale | ... | ... | ... | ... | ... | ... | ... | ... | 12 | 0 |
| Coal (splint) | ... | ... | ... | ... | ... | ... | ... | ... | 1 | 8 |
| Under clay | ... | ... | ... | ... | ... | ... | ... | ... | 4 | 0 |
| Shale | ... | ... | ... | ... | ... | ... | ... | ... | 7 | 0 |
| Coal | ... | ... | ... | ... | ... | ... | ... | ... | 0 | 3 |
| Under clay | ... | ... | ... | ... | ... | ... | ... | ... | 3 | 6 |
| Shale | ... | ... | ... | ... | ... | ... | ... | ... | 8 | 0 |
| Under clay | ... | ... | ... | ... | ... | ... | ... | ... | 2 | 0 |
| Hard post | ... | ... | ... | ... | ... | ... | ... | ... | 25 | 0 |
| Ditto and shale | ... | ... | ... | ... | ... | ... | ... | ... | 19 | 0 |
| Shale | ... | ... | ... | ... | ... | ... | ... | ... | 8 | 7 |
| Coal | ... | ... | ... | ... | ... | ... | ... | ... | 3 | 1 |
| Argillaceous shale | ... | ... | ... | ... | ... | ... | ... | ... | 18 | 0 |
| Grey metal | ... | ... | ... | ... | ... | ... | ... | ... | 9 | 0 |
| Post | ... | ... | ... | ... | ... | ... | ... | ... | 6 | 0 |
| Ditto and grey metal | ... | ... | ... | ... | ... | ... | ... | ... | 20 | 0 |
| Grey shale | ... | ... | ... | ... | ... | ... | ... | ... | 12 | 0 |
| Coal | ... | ... | ... | ... | ... | ... | ... | ... | 3 | 11 |
| Under clay | ... | ... | ... | ... | ... | ... | ... | ... | 3 | 0 |
| Freestone | ... | ... | ... | ... | ... | ... | ... | ... | 1 | 0 |
| Grey shale | ... | ... | ... | ... | ... | ... | ... | ... | 11 | 0 |
| Total | ... | ... | ... | ... | ... | ... | ... | ... | 248 | 0 |

The beds are in the usual basin form, which is here narrowed to an inconsiderable width, the opposite crops of one of the seams being about 500 yards apart. Slopes have been driven in the crop of the upper seam. On the north side of the basin it dips to the south irregularly, owing to some faults, the strike being nearly due east. On the south crop the angle of dip is 14° , and the course of the strike S. 45° E. In the lower seam, at the McKay slope, the dip is 13° , and the strike S. 30° E. Two miles eastward of these mines two seams have been found, the position of which affords another illustration of the complications that abound in this part of the coal-field. One of these seams is a very fine bed of coal, 8 feet 6 inches thick. It dips to the N.W. at an angle of 35° . The range of this bed has been traced nearly a mile in an easterly direction; towards the west it is cut off by a fault, which is supposed to be either the south-side fault before mentioned, or a branch from it.

The peculiar disposition of these beds of coal will be evident on a reference to the map. Although the various openings are not very distant from each other, there is so much space between them still unproved

that it is difficult to define their relationship, and some time must elapse before the extent and contents of this coal-field can be ascertained.

Coal has been found at various places outside of the localities named in the preceding description; and although no seam of any importance has yet been discovered, there does not appear to be any geological hindrance to the existence of beds of a workable size in other parts of the carboniferous deposit in this country. The bord and pillar system of working is followed in all the mines in this district; indeed it is, with very few exceptions, that generally practised throughout the province. The mode of extracting the coal varies in accordance with the peculiarities of each seam as regards its division by ordinary partings or interstratified bands of shale or clay. It may not be uninteresting to describe the process adopted in the large seams of the Albion Mines and in the lesser but still unusually thick beds of the Acadia Colliery. A want of uniformity of quality in the component divisions of the main seam has regulated the choice of that portion for working which was considered to be the best. A large extent of the early workings is, in consequence, in the upper part of the seam, a thickness of about 12 feet only having been mined. In some parts of the mine the lower portion of the seam has also been worked, one of the divisions varying from 3 to 4 feet in thickness, including a band of ironstone 18 inches thick being left between it and the upper works.

The following section will show another arrangement of the operations:—

| | | | | | | | | | Ft. | In. | |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----------|
| Coal | ... | ... | ... | ... | ... | ... | ... | ... | 4 | 0 | } left. |
| Ironstone | ... | ... | ... | ... | ... | ... | ... | ... | 1 | 2 | |
| Coal | ... | ... | ... | ... | ... | ... | ... | ... | 9 | 3 | } worked. |
| Ironstone | ... | ... | ... | ... | ... | ... | ... | ... | 2 | 8 | |
| Coal | ... | ... | ... | ... | ... | ... | ... | ... | 8 | 0 | } left. |
| Coal | ... | ... | ... | ... | ... | ... | ... | ... | 14 | 0 | |

As the position of the pillars in each division has not been regulated by that of those first formed, bords are frequently immediately beneath pillars, and *vice versa*, and the workings are, in consequence, somewhat complicated in character, and present at first sight rather a puzzling appearance. In some instances nearly the entire seam may be said to be mined at one operation; thus in working the pillars, which has lately been done to some extent, the coal that has been left will occasionally break away and expose the pillar in the upper workings, which, if the coal is considered worth taking, is also removed. This is accomplished by working the upper portion in advance of the lower in the form of a

series of steps. When a portion only of the seam is worked, as, for instance, the 14 feet in the above section, it is taken out by a similar arrangement of steps or benches, a holing or kirving being made in the most suitable part for removing the upper bench; the lower bench being kept a few feet back, and mined in regular progression in the ordinary manner.

A peculiarity of this seam, and one that adds much to the risk attending these operations, is the frequent occurrence of vertical fractures in the coal locally termed "lypes." These are occasionally slightly open, forming fissures, but their general character is similar to the ordinary "backs" of most coal seams. The faces of the fracture are frequently slicken-sided, and an additional source of danger is thus attached to them, requiring great care in preventing accidents.

The bords are driven 6 yards wide and parallel to the levels; they are turned out of balance ways or headings, which are put up to the full rise at intervals of 150 yards, the width of the pillar between being from 8 to 10 yards. These balance ways are used to bring the coal down to the horse road, on the principle of a self-acting incline; the only difference being that a loaded bogie raises the empty tub to the respective bord ends, and it is, in its turn, taken back by the tub of coal, which exceeds it in weight. The bords are driven in opposite directions from these inclines, to shorten the putting.

A mode of payment has been practised at this colliery for some time, which is worth mentioning, as it possesses some advantages over that usually adopted. Instead of the price being per tub or ton, it is per cubic yard. Each place is measured once a month, to ascertain the average height and width and the distance driven; the cubical contents are then calculated, and the hewers and putters, who are generally in sets or gangs of three or four men for each place, are paid at the agreed price per yard. At present, 41 cents. or 1s. 7½d. per cubic yard is paid in the whole workings, and 35 to 38 cents. = 1s. 4½d. and 1s. 6½d. in the pillars. The capacity of the tub used is about half-a-ton, but as the men put their own, or at least find the putter, they have no inducement to send away ill-filled tubs, but on the contrary, to shorten the number of trips made to the balance ways by filling the tubs well; the coal is therefore built up in them near the top, and a much larger quantity is thus conveyed per tub. It will be obvious that this method has the further advantage of simplifying the keeping of the daily accounts.

At the Acadia Colliery the general arrangements for working the seam are similar to those at the Albion Mines. The seam, as shown by

the section, is 19 feet thick; in the portion above the clay band, there are two distinct partings, one being 13 inches from the top of the seam, and the other 2 feet 2 inches lower. As the roof is not strong, the top coal, 13 inches, is left, and the first working is in the coal between it and the clay band, in which the kirving is made; the thickness of coal varying from $5\frac{1}{2}$ to 6 feet. The lower bench is then taken up the remaining thickness, less about 2 feet 6 inches of coarse coal next the bottom.

The price at this colliery is by the lineal yard: in the bords which are driven 15 feet wide, 4.50 dollars or 18s. per yard is paid; and in the levels 12 feet wide, 5.50 dollars or 22s. per yard. For these prices the hewers lay the tramway and put in all timber required.

This important coal district possesses the inestimable advantage of a first class harbour in which to ship its product. Three rivers, termed respectively the East, Middle, and West rivers unite their streams near the town of Pictou, and form, in conjunction with the waters of the Northumberland Strait, a capacious and well sheltered harbour. On the former of these rivers, and about three miles from Pictou, the General Mining Association have their staiths or loading ground which is connected with the mines by a railway, and is distant from them about $5\frac{1}{2}$ miles. The Nova Scotia railway passes close to the mines and terminates on the southern shore of the harbour a little below Pictou. Shipping berths have recently been erected here by the Acadia and other companies, the distance from the Acadia Mines being thirteen miles. About two miles up the Middle river the Intercolonial Company have extensive shipping erections, and a railway from the river to the mine seven miles in length; and the Nova Scotia Company are about to connect their mine in a similar manner with a shipping place on that river. There are thus ample facilities in this respect. At the eastern extremity of the coal-field, the harbour of Merigomish will probably, in no distant day, be brought into service, and this important and valuable coal-field will possess the unusual advantage of access to shipping on three of its sides, none of which is far distant from the central operations. One drawback to this privilege is the suspension of shipment during the winter. For about four months the rivers and the harbour are frozen up, and navigation in consequence entirely stopped. During this time, however, the mines are not laid idle, but are continued at work, the coal raised being stored at bank. This necessarily involves a considerable waste of coal as well as other disadvantages (those of a pecuniary character not being the least) which appear to be unavoidable; though so far as the waste of coal

is concerned suitable erections to protect it from the weather would no doubt be of benefit. A portion of the coal might also be stored underground at less risk of injury and cost of relifting. The price of the coal on board of ship is 2.25 dollars or 9s. per ton. Until within the last twelve months it has been chiefly exported to the United States; but since the opening of the Acadia and Intercolonial Mines, a trade with the Canadian Provinces has been begun which is likely to be largely extended. The exchange of the products of each province, where it can be effected without a strain on the natural course of such operations, must be attended with mutual advantage; and as the cost of transit by the establishment of this trade must be much less on each article than it would be if the trade were in one course only (inasmuch as vessels will be able to get a return freight in each case, and the unprofitable carriage of ballast be avoided), it is evident that the cultivation of this trade must be attended with important consequences to this coal-field. Freights average about 8s. 6d. per ton to the States or Quebec or Montreal.

The general character of the coal is bituminous, with much variation in the quality. The composition of the main seam has been alluded to as well as the changes which occur, both east and west of the early workings. An interesting series of assays, made by Dr. Dawson, gives an excellent illustration of the variableness of its composition, and of the change in quality in different districts of the mine. They are as follows :—

| | | | | | | S. E. Side. | N. W. Side. |
|--------------|---|----------------------|-----|-----|-----|---------------|---------------|
| Roof coal | { | Moisture | ... | ... | ... | 1·750 | 1·550 |
| | | Volatile combustible | ... | ... | ... | 25·875 | 27·988 |
| | | Fixed carbon | ... | ... | ... | 61·950 | 60·837 |
| | | Ashes | ... | ... | ... | 10·425 | 9·625 |
| | | | | | | <hr/> 100·000 | <hr/> 100·000 |
| Top bench | { | Moisture | ... | ... | ... | 1·500 | 1·500 |
| | | Volatile combustible | ... | ... | ... | 24·800 | 28·613 |
| | | Fixed carbon | ... | ... | ... | 51·428 | 61·087 |
| | | Ashes | ... | ... | ... | 22·272 | 8·800 |
| | | | | | | <hr/> 100·000 | <hr/> 100·000 |
| Bolton bench | { | Moisture | ... | ... | ... | 2·250 | 1·800 |
| | | Volatile combustible | ... | ... | ... | 22·375 | 27·075 |
| | | Fixed carbon | ... | ... | ... | 52·475 | 59·950 |
| | | Ashes | ... | ... | ... | 22·900 | 11·175 |
| | | | | | | <hr/> 100·000 | <hr/> 100·000 |

The specific gravity of the best coal was 1·288, and that of the inferior 1·447; a mean of six samples from the top, middle, and bottom of the seam is 1·325. A recent analysis of the seam, made by Professor How, of King's College, Windsor, gives the following:—

| | | | | | | | |
|-------------------------|-----|-----|-----|-----|-----|-----------|---------------|
| Moisture | ... | ... | ... | ... | ... | 1·48 | |
| Volatile combustible | ... | ... | ... | ... | ... | 24·28 | |
| Fixed carbon | ... | ... | ... | ... | ... | 66·50 | } 74·24 Coke. |
| Ash | ... | ... | ... | ... | ... | 7·74 | |
| | | | | | | 100·00 | |
| Sulphur | ... | ... | ... | ... | ... | 0·55 | |
| Specific gravity | ... | ... | ... | ... | ... | 1·294 | |
| Theoretical evap. power | ... | ... | ... | ... | ... | 9·13 lbs. | |

The samples were obtained from the new opening, 300 yards to the dip of the old workings. The analysis shows a considerable diminution in the quantity of ash. An analysis of samples from the deep seam, also by Professor How, gave:—

| | | | | | | | |
|-------------------------|-----|-----|-----|-----|-----|-----------|---------------|
| Moisture | ... | ... | ... | ... | ... | 2·54 | |
| Volatile combustible | ... | ... | ... | ... | ... | 20·46 | |
| Fixed carbon | ... | ... | ... | ... | ... | 68·50 | } Coke 70·10. |
| Ash | ... | ... | ... | ... | ... | 8·50 | |
| | | | | | | 100·00 | |
| Sulphur | ... | ... | ... | ... | ... | 1·69 | |
| Specific gravity | ... | ... | ... | ... | ... | 1·345 | |
| Theoretical evap. power | ... | ... | ... | ... | ... | 9·41 lbs. | |

These seams have no regular cleavage; the coal breaks off, therefore, in large irregular shaped pieces, which retain their size well “in the heap.” The coal is used extensively for gas purposes in the States, and is also in much local demand on account of its purity and other qualities. The Boston Gas Light Co. state that it yields 7180 feet of gas to the ton, of 15 candle gas, and that when it is worked to high heat it yields more gas, but to the injury of the coke. At Halifax 8000 feet have been taken from it. For general use, it is remarkable for giving out much heat, and for keeping alight much longer than other coal.

The McGregor seam, the Stellar coal, and the seam opened at the Acadia, Nova Scotia, and Intercolonial Collieries, possesses the following interesting characteristics.

An analysis of the upper and lower benches of the McGregor seam gave—

| | | | | | | | |
|--------------------|-----|-----|-----|-----|-----|--------|--------|
| | | | | | | Upper. | Lower. |
| Volatile Matter | ... | ... | ... | ... | ... | 22.50 | 23.30 |
| Fixed Carbon | ... | ... | ... | ... | ... | 65.70 | 70.00 |
| Grey Ash | ... | ... | ... | ... | ... | 11.80 | 6.70 |
| | | | | | | 100.00 | 100.00 |
| Specific gravity | ... | ... | ... | ... | ... | 1.334 | 1.301 |
| Theor. evap. power | ... | ... | ... | ... | ... | 9.02 | 9.51 |

A mixture of the two benches is said to have yielded at the Manhattan Gas Works, New York, 9,500 feet of 13 candle gas.

The Stellar coal seam, though not at present mined for the reason before mentioned, is an interesting bed with respect to its composition. The bituminous coal, the oil coal, and the shale into which it is divided have been analysed by Professor How, with the following results :—

| | | | | | | | |
|-----------------|-----|-----|-----|-----|--------|-----------|--------|
| | | | | | Coal. | Oil Coal. | Shale. |
| Volatile matter | ... | ... | ... | ... | 33.58 | 66.56 | 30.65 |
| Fixed carbon | ... | ... | ... | ... | 62.09 | 25.23 | 10.88 |
| Ash | ... | ... | ... | ... | 4.33 | 8.21 | 58.47 |
| | | | | | 100.00 | 100.00 | 100.00 |

An analysis, also by that gentleman, of the seam worked at the above named collieries, is as follows :—

| | | | | | | | |
|----------------------|-----|-----|-----|-----|-----|--------|--------------|
| Moisture | ... | ... | ... | ... | ... | 8.70 | |
| Volatile combustible | ... | ... | ... | ... | ... | 23.94 | |
| Fixed carbon | ... | ... | ... | ... | ... | 67.40 | } Coke 72.36 |
| Ash | ... | ... | ... | ... | ... | 4.96 | |
| | | | | | | 100.00 | |
| Theor. evap. power | ... | ... | ... | ... | ... | 9.26 | |

The peculiar properties of the Stellar seam are implied in the analysis and need no further remark; these may not be so evident, however, in that last given. The seam from which the sample was taken is found to be an excellent steam coal, and to possess the important qualities of yielding very little smoke and giving a good heat. It has a more decided cleavage than either the Main or the Deep seam, and its fracture is in consequence cubical. It is obtained in large square shaped pieces, and is lustrous and clean. For domestic use it has a good reputation.

A comparison of the character of the coal on the north side of the Albion Mines Basin with the recent analysis of the main seam above given, is afforded by the following analysis of coal from the Montreal and Pictou Colliery :—

| | | | | | | | |
|-----------------|-----|-----|-----|-----|-----|-----|---------|
| Volatile matter | ... | ... | ... | ... | ... | ... | 25.40 |
| Fixed carbon | ... | ... | ... | ... | ... | ... | 68.55 |
| Ash | ... | ... | ... | ... | ... | ... | 6.05 |
| | | | | | | | 100.00* |
| Coke | ... | ... | ... | ... | ... | ... | 74.60 |

* Prof. How.

Analyses have also been made of coal from the seams on the east side of East River. The peculiarities of composition of these beds will be seen in the following :—

| | | | | | 1 | 2 | 3 |
|-----------------|-----|-----|-----|-----|---------|-------|-------|
| Volatile matter | ... | ... | ... | ... | 25.4 | 31.4 | 29.0 |
| Fixed carbon | ... | ... | ... | ... | 50.0 | 63.6 | 53.4 |
| Ash | ... | ... | ... | ... | 24.6 | 5.0 | 17.6 |
| | | | | | — | — | — |
| | | | | | * 100.0 | 100.0 | 100.0 |
| Coke | ... | ... | ... | ... | 74.6 | 68.6 | 71.0 |

The first of these analyses is from the seam opened on the Montreal and New Glasgow Co.'s property, in the vicinity of Coal Brook, and on the east side of the fault; the second is from the lower seam in the section of the Pictou Mining Co.'s shaft, but taken from an opening in the crop to the south-west of that shaft; and the third is from the $4\frac{1}{2}$ feet seam on the west side of the fault at Coal Brook.

Thirty-five miles north-east from Pictou, in the county of Antigonish, some seams of coal have been recently found, which, together with a large deposit of shale, said to be of an oil yielding character, have excited an interest in this locality. So little has been done, however, to test the value of the discovery, that the writer can but state what is conjectured respecting the form of this coal-field, as indicated by the position of the beds and other circumstances. There are said to be five seams, varying from 2 feet to upwards of 9 feet in thickness, with a dip to the N.W. of about 35° . They appear to be in a narrow trough, the northern edge of which is bordered by lower carboniferous and igneous rocks; the average breadth of the trough being about one and a half miles.

Openings have been made from the crop in one of the seams, but they are yet too limited in extent to allow an opinion to be formed of the character of the coal, and they are besides evidently in disturbed ground.

The oil shales have been examined by a provincial geologist of some reputation, and are said by him to be upwards of 200 feet thick. Some of the beds, he is of opinion, will yield from 40 to 50 gallons per ton; the manufacture of oil from these sources being, however, at present rather at a discount, no attempt has been made to utilize them.

It is conjectured by Dr. Dawson, that the Antigonish basin is the southern edge of a coal-field underlying the sea, in a north-east course,

* Dr. Dawson.

and that the eastern side of it is at Port Hood, distant in that direction about 27 miles. The operations at both these places are yet, however, on so small a scale, and from their being on the crop, and therefore, exposing scarcely any of the beds, so little is known of the strata that the identification of the relative position in the series of the seams at each of these localities, assuming the connection suggested, has yet to be determined.

In describing the different coal-fields or localities in which coal operations are carried on, the writer has proceeded in an easterly direction, and as they nearly all, as before remarked, border on the shore, by continuing along the coast line they will be noticed in the order of their geographical position with respect to the starting point at the Joggins. On referring to the map (see Plate I.) it will be seen that Port Hood is situated in the island of Cape Breton. The northern shore of this island consists, for a considerable distance, of carboniferous rocks, in which there are several detached coal-bearing tracts; the beds of coal in these tracts seem to be on the southern edges of a series of narrow troughs, which are separated from each other by masses of rock jutting into the sea, with, in some places, low and comparatively level spaces between them. Whether the beds fold round these intervening projections and form one large basin, or they maintain their isolation, is not yet ascertained.

At Port Hood, one seam only has been opened; it crops out near the shore, along which it extends $1\frac{1}{2}$ miles, and trending northward at each end passes into the sea; the extreme distance of the crop from high-water mark being about 220 yards. This seam dips to the N.W. at an angle of 27° , and is of the following average section :—

| | | | | | | | | Ft. | In. |
|-----------------------|-----|-----|-----|-----|-----|-----|-----|-----|----------------|
| Coal (coarse). | ... | ... | ... | ... | ... | ... | ... | 1 | 0 |
| „ with bands of shale | ... | ... | ... | ... | ... | ... | ... | 0 | $9\frac{1}{2}$ |
| „ (good) | ... | ... | ... | ... | ... | ... | ... | 4 | 3 |
| | | | | | | | | 6 | $0\frac{1}{2}$ |

The underlying strata have been examined at various points on the surface, over a distance of nearly three-quarters of a mile from the shore; and although several seams were found, none of them exceeded twenty inches in thickness. Overlying the seam worked, 360 feet, there is another bed the thickness of which has not been correctly ascertained, as it is entirely under water; but the crop is occasionally seen when the tide is low, and it is supposed to be not less than six feet thick. Between Port Hood and Margarie, a distance of forty-five miles, seams of coal

appear in the cliffs at several places, but in a more marked form at Mabon, Broad Cove, and Chimney Corner. At the former of these the beds first reached in proceeding northward dip to the north at an angle of 70° . In a distance along the shore of about 200 yards there are indications of six or seven seams of coal, four of which are well defined; the others are evidently much disturbed, and their size and character cannot yet be declared. Of the four the lowest in the order of deposition is from 3 feet to $4\frac{1}{2}$ feet thick, including from 12 to 18 inches of cannel coal. Above this seam, and separated from it by only a few feet of shale, is one the thickness of which is 13 feet; and overlying this last there is another 7 feet thick, which is also overlaid by one 5 feet in thickness. About half-a-mile to the north, seams are found in an entirely reversed position, and with such strong points of resemblance that there remains no reason to doubt their identity with those to the south of them. The measures in this locality are thus in the usual basin shape. They sweep inland a short distance from the shore, and form the eastern edge of the basin, which probably extends under the sea a considerable distance. Further north, about 1,100 yards, seams are again exposed, with a northerly dip, one of which resembles the thirteen feet seam, and appears to establish a connection with that series. The edge of the basin would seem to have been in an undulatory form, and to have suffered considerable denudation, by which the connection of the beds was destroyed. The extent which these last named seams range northwards is not yet ascertained.

At Broad Cove a seam 7 feet thick has been exposed with a northerly dip, and others of smaller size also appear in the cliffs. The position of these beds is similar to those at Mabon, but they seem to range further inland. So little has yet been done, however, to ascertain their extent, that a reference to them is all that can at present be said about them. Between Broad Cove and Chimney Corner, a distance of ten miles, the land adjoining the shore is for the most part low and flat, and there is not, therefore, the same facility for examining the strata. No seams, so far as the writer can learn, have yet been found between these places, and the relation of the two localities, should there be any connection, has yet to be established.

At Chimney Corner the beds are well defined. Three seams are exposed, the lowermost in the series being 3 feet 6 inches thick. It is overlaid by one 5 feet thick, from which it is separated by about 200 feet of strata; and 88 feet above this last there is another 3 feet thick. They dip to the north-west at an angle of 40° . The extent to which

these beds spread inland is not yet known; it is probable that like the Mabon series they are on the edge of a basin, the greater portion of which is either denuded or at a considerable depth under the sea. And it may be further conjectured that they are not disjointed carboniferous tracts but portions of one large coal-field, of which time and tide have left only these few landmarks.

The carboniferous formation extends eastward from Chimney Corner to Cheticamp, a distance of 25 miles; and although seams of coal appear in the cliffs between these places, no attempt has been made to open them, probably from their not being of a workable size. A short distance beyond Cheticamp the measures terminate against Silurian rocks, of which the northern portion of the island consists. This Silurian tract is about thirty miles in width, in a south easterly direction from Margarie, and it is on its eastern flank that the carboniferous measures again make their appearance, where they range on the same course, S.E., and form the eastern coal-field of Cape Breton. Plate IV.

Extending along the eastern shore of the island, a distance of about 35 miles, and spreading inland quite as far, this formation, although productive chiefly on its eastern side, possesses an economical value that can scarcely be over estimated.

The range of the coal bearing strata over such a distance is not, as may be supposed, an unbroken one; nor is the position of the seams, as respects the order of their sequence therein, easy of recognition in the different localities into which this coal-field is divided. It has had the advantage, however, of a skilful examination of the greater part of it by gentlemen well qualified for such a task, and its general form is much better known than that of the other coal-fields.

The divisions above referred to are known as the Sydney, the Glace Bay, and the Cow Bay districts, these distinctions being local as regards the situation of the collieries, and geological as regards the separation formed by an anticlinal of a very prominent character between Cow Bay and Glace Bay, and by a similar but less defined line between the latter place and Sydney.

The beds are in the usual trough-like form between these anticlinals, and their crops have a circular or elliptical outline in accordance with the longitudinal range of the trough, and the distance between the anticlinals.

Although several collieries have been opened in these districts, and considerable knowledge has been obtained of each, their mutual relation has not yet been clearly defined; and much doubt still exists with

respect to the identity of the seams in each division. As it is not the writer's intention in this paper to treat any part of the subject of it in a controversial spirit, but simply to describe the different seams in each locality, and to give a few particulars respecting the mining and disposal of the coal, he will but briefly refer to such connections as appear to be established, and will endeavour to convey a knowledge of each seam in the respective districts, and of their relation to each other, without regard to the question of geological position. It may be stated, however, that Dr. Dawson is inclined to the belief in the greater age of the Sydney series, whilst Prof. Lesley, of New York, who made an examination of the Cow Bay and Glace Bay districts, thinks the measures are identical. As some of the more striking peculiarities of this coal-field will, perhaps, be best understood by taking the Glace Bay series first, the different seams in that district will now be described. The most extensive surface development of the series is about midway between Sydney Harbour and Cow Bay; the measures are there in a very regular position, and of a broad basin shape. A section across the basin in a north and south direction exhibits nearly all the seams in this coal-field, assuming the identification of some of them in each district. They probably exceed twenty in number, with an aggregate thickness of workable coal of upwards of 40 feet; there being in this section seven or eight of a workable size. The uppermost in the series is called the Hub seam; it is worked by the Glace Bay Company, on whose property it not only crops out at an extreme distance from the shore of about three quarters of a mile, but has also its northern and southern bassets. The Company is thus the sole possessor of the portion of the seam not covered by water. It dips where at present worked to the east at an angle of 5° , and is of the following section:—

| | | | | | | | | Ft. | In. |
|------------------|-----|-----|-----|-----|-----|-----|-----|-------|-----|
| Top coal, coarse | ... | ... | ... | ... | ... | ... | ... | 1 | 2 |
| Coal, good | ... | ... | ... | ... | ... | ... | ... | 5 | 6 |
| Hard band | ... | ... | ... | ... | ... | ... | ... | 0 | 1½ |
| Coal, good | ... | ... | ... | ... | ... | ... | ... | 3 | 0 |
| | | | | | | | | <hr/> | |
| | | | | | | | | 9 | 9½ |

It is subject to irregularities in the floor which cause it to vary occasionally in thickness, but in other respects it is a remarkably uniform and fine seam of coal. About 20 feet below it there is a bed of cannel coal two feet thick, which is not, however, sufficiently pure throughout this thickness, to make it workable; and at a depth of 500 feet below it is the "Harbour" seam, of which the section is as follows:—

The position of these seams is scarcely so clear on the north side of Lingan Bay as it is on the south side of Glace Bay, explorations not having been made to the same extent; it will, therefore, perhaps be best to show their connection on that side, and then to endeavour to trace them northwards.

The coast line on the north side of the headland on which the "Hub" seam commences the series, retires considerably to the west, and as the strike of the seam trends eastwardly, that is, in the contrary direction, the upper beds, including the "Harbour" seam, pass into the sea a short distance along the coast and are not again seen, unless those in the cliffs between Lingan and Sydney Harbour are their representatives. The lower seams appear to maintain their regular position; they stretch away to the eastward over a broad point of land between Big Glace Bay and Schooner Pond, on the southern shore of which they also disappear in the sea. Two of the seams have been worked in this locality, the "Phelan" at the Clyde Colliery and the "Ross" at the Schooner Pond. Their sections at these mines as are follows:—

| CLYDE. | | | | SCHOONER POND. | | | |
|-------------|-----|-----|---------|-----------------------|-----|-----|--------------------------------|
| | | | Ft. In. | | | | Ft. In. |
| Top coal | ... | ... | 1 6 | Coal, with clay bands | | | 1 4 |
| Coal | ... | ... | 6 0 | Coal | ... | ... | 0 4 $\frac{1}{2}$ |
| Bottom coal | ... | ... | 1 0 | Band, hard | ... | ... | 0 1 |
| | | | — | Coal | ... | ... | 3 7 $\frac{1}{2}$ |
| | | | 8 6 | Band, soft | ... | ... | 0 3 |
| | | | | Coal | ... | ... | 1 3 |
| | | | | | | | <hr/> 6 11 $\frac{1}{2}$ <hr/> |

On the northern flank of the promontory, which forms the northern head of Cow Bay, there are two seams separated by 3 feet of sandstone; the upper coal being 1 foot 9 inches, and the lower 4 feet 6 inches thick. These seams, notwithstanding their variation in size and in other respects, are supposed to be the representatives of the "Spencer" bed. The position of another seam at the extreme end of the "head" is also assumed to agree with that of the "Ross." There is here, however, a somewhat sudden change in the strike of the beds, which seems to have been caused by a cross ridge or anticlinal in connection with the main one to the south of it, and the identity does not appear yet to be of an undoubted character.

It may convey some idea of the extent of coal in the tract of country between Lingan and Schooner Pond, to state that the distance between these places in a direct line from the crop of the lower seam at Schooner

Pond to its crop at Lingan is about 12 miles, and that it probably sweeps inland at some parts upwards of 5 miles.

Stretching between the series of beds just described and those in the Cow Bay district is the northern head of that bay, which running into the sea in an easterly direction, separates these localities in a very marked and prominent manner. The position of the Cow Bay portion of the coal-field is so peculiar and isolated in its relation to the Glace Bay and Bridgeport districts, that at first sight its connection with them might be very easily doubted. It does, however, but illustrate in a more forcible manner than is elsewhere shown the undulatory outline of the coal-bearing rocks which prevails so extensively along the shores of the Province. As already stated it is separated from Glace Bay by an anticlinal of a well defined character. This anticlinal opposes a bold headland to the sea, and ranging inland it becomes gradually reduced in size till at a distance of 8 miles from the shore it appears to terminate. The coal beds on the south side of it extend upwards of 6 miles to the west of the "head," and are in the form of a narrow trough; the transition from a southerly to a northerly dip occurring at the western end in a very short space. The east end has been destroyed by the sea to such an extent that the coast line of the north side of the bay is for a distance of 7 miles nearly at right angles to the course of the main shore; and as the centre of the trough is parallel with the course of the anticlinal, this coast line is in an oblique direction across the measures, and the curious spectacle is exhibited of an exposure of the same seams at opposite sides of the trough in the short space of 3 miles.

Two seams only have been mined in this district; the uppermost is known as the "Block House" seam, from its being worked at the Block House Colliery, but it is said by Professor Lesley to be the "Harbour" seam of the Glace Bay district. The upper beds and that seam in this case are covered by the sea the entire distance between where they disappear near Little Glace Bay Harbour and reappear at Cow Bay. The Block House seam has been very extensively worked; it is a fine bed of coal of the following section:—

| | | | | | | | | | Ft. In. |
|-----------------|-----|-----|-----|-----|-----|-----|-----|-----|------------------|
| Top Coal (left) | ... | ... | ... | ... | ... | ... | ... | ... | 1 0 |
| Coal | ... | ... | ... | ... | ... | ... | ... | ... | 7 10 |
| | | | | | | | | | <hr/> 8 10 <hr/> |

There is a noteworthy peculiarity in this seam which deserves mention. It is undisturbed by faults over an extensive range of workings, and but for the peculiarity alluded to, it might be considered a very fine specimen

of a bed of coal. This peculiarity consists of masses of shale which intercept the workings in a very singular manner. See Plate VI. Of the most irregular shape, they sometimes present a perfect face of stone in the working places, and at first sight would be taken for faults; on cutting through them, however, the seam is found on the same level and the coal unaltered in any respect. They are occasionally several yards thick; sometimes they are wedge-shaped, running to a point at the bottom of the seam, and are often of the most fantastic forms. From the fact of there being a bed of shale overlying the coal, and also that in only one instance are they connected with the floor of the seam, it appears reasonable to infer that they have been thrust into fissures in the coal; but how these have been caused without disturbing the general shape of the bed is not so evident. A proof of motion in the material is the strongly slicken-sided markings in the shale. The diagrams are from sketches made by the writer in the mine.

The action of the anticlinal is well shown at this colliery. The seam from its southern crop has a gentle dip to the N.E., at an angle of 5° , which continues a distance of six hundred yards; it then suddenly begins to rise, and is thrown out to the surface at an angle of 45° . A thickness of strata of about thirty fathoms separates this seam from the "McAulay" bed, so called in this locality, but which is considered to be the equivalent of the "Phelan" seam in Glace Bay. It is worked at the Gowrie Colliery, where it is of the following section :—

| | | | | | | | | |
|-------|-----|-----|-----|-----|-----|-----|-----|------------------|
| Coal | ... | ... | ... | ... | ... | ... | ... | Ft. In. |
| | | | | | | | | 2 2 |
| Shale | ... | ... | ... | ... | ... | ... | ... | 0 0½ |
| Coal | ... | ... | ... | ... | ... | ... | ... | 2 8½ |
| | | | | | | | | <hr/> 4 11 <hr/> |

Between the northern crop of the McAulay seam and the northern "Head," several seams crop out; their relative position being summarised as follows, the depths being vertical to the dip :—

| | | | | | | | |
|-------------------|-----|-----|-----|-----|-----|-----|---------|
| McAulay seam | ... | ... | ... | ... | ... | ... | Ft. In. |
| | | | | | | | 4 11 |
| Sundry strata | ... | ... | ... | ... | ... | ... | 200 0 |
| Spencer seam | ... | ... | ... | ... | ... | ... | 2 8 |
| Sundry strata | ... | ... | ... | ... | ... | ... | 50 0 |
| McRury seam | ... | ... | ... | ... | ... | ... | 4 4 |
| Sundry strata | ... | ... | ... | ... | ... | ... | 100 0 |
| Coal, 3 feet seam | ... | .. | ... | ... | ... | ... | 3 0 |
| Sundry strata | ... | ... | ... | ... | ... | ... | 50 0 |
| Coal, 2 feet seam | ... | ... | ... | ... | ... | ... | 2 0 |

| | | | | | | | | Ft. | In. |
|-----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Sundry strata | ... | ... | ... | ... | ... | ... | ... | 100 | 0 |
| Coal | ... | ... | ... | ... | ... | ... | ... | 1 | 6 |
| Sundry strata | ... | ... | ... | ... | ... | ... | ... | 100 | 0 |
| Long Beach seam | ... | ... | ... | ... | ... | ... | ... | 3 | 0 |

The declination of these seams brings them to the surface within a comparatively short distance from each other. On the southern side of the basin, where the dip is much less, their crops have, of course, a corresponding extension. Unfortunately, however, these crops are for some distance under the sea, the bay occupying a large extent of the space between the southern head and the main land. At the extreme end of that head the seams again appear, and one of them has been opened at the South Head Colliery. It is supposed to be the Spencer seam; it differs much from the section of that seam near the Gowrie Mine, and its identity seems to be based at present rather on the assumption of an unbroken range of the strata, than on any similarity in other respects. At the South Head, it consists of several beds of coal separated by shales; of the portion worked, the lowest is 3 feet 6 inches thick; it is overlaid by 2 feet 4 inches of shale, and that again by coal with clay bands, 3 feet 6 inches thick. Passing through the narrow point of land which forms the head, it is seen in the cliff on the southern side, and then disappears in the sea.

Between the "Head" and False Bay beach, several beds of coal are exposed in the cliff; an examination of these would, no doubt, determine their relation to those already named, and fix more definitely than exists at present the true character of this portion of the coal-field.

Only one of these seams has been opened; it is called the "Tracey" bed, and is worked at the Miré Bay Colliery, where it is of the following section, with a dip to the N.E. of 7°:—

| | | | | | | | | | Ft. | In. |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Coal | ... | ... | ... | ... | ... | ... | ... | ... | 2 | 6 |
| Fire clay | ... | ... | ... | ... | ... | ... | ... | ... | 0 | 10 |
| Coal | ... | ... | ... | ... | ... | ... | ... | ... | 1 | 2 |
| | | | | | | | | | 4 | 6 |

This seam is supposed to underlie the Spencer seam 2,400 feet; it is at present the lowest workable bed in the series. Its north-easterly dip is in conformity with the upper beds worked at Gowrie and Block House, and suggests the probability of the wide range of the crop shown on the map.

The southern shore of the South Head affords the last section of this interesting and valuable coal-field; the easterly strike of the beds carries

them in a transverse direction across the headland, whence they pass into the sea, and all further knowledge of them in that direction ceases. Having now, it is hoped, made as clear as existing knowledge permits, the position of the seams at this extremity of the coal-field, it is necessary, in order to trace their course northwards, to revert to the Glace Bay district as a starting point for that purpose. It was remarked, that in their Bridgeport tract, the General Mining Association had at one time worked a seam, which is considered to be the "Phelan." Although this seam differs both in its size and in the direction of the dip from that worked at the Caledonia Colliery, there appears to be little reason to doubt their identity; the variation in thickness being not unusual, as has been already observed, and the alteration in the strike being in accordance with the general course of one of the upper beds, as proved at the International Colliery.

The entire series up to this point appears to be regular and unbroken. On the northern shore of Indian Bay, however, the strike of the seams is almost at right angles to that of those on the Bridgeport side, and as the distance between the shores of the bay is only $1\frac{3}{4}$ miles, it is evident that there is a disturbance of the beds in this locality. The change in their position is attributable to a second anticlinal, the range of which is similar to that between Cow Bay and Glace Bay. The shape of this portion of the coal-field is so entirely different to the last named district that the peculiarity of position is almost as strongly marked as at Cow Bay.

The sweep of the beds between Lingan and Spanish River has a convex form as regards the sea, whereas between Lingan and Schooner Pond it is the reverse, thus affording another illustration of that peculiar contour of the carboniferous strata to which attention has before been drawn.

From the northern head of Indian Bay to Low Point at the entrance to Spanish River, the coast section exhibits a succession of beds of coal which on the assumption of the identity of any one of them with one of those on the Bridgeport side must be considered to be the representatives of those under or overlying that particular seam. This identity has been attached to a seam which is worked at Lingan Colliery by the General Mining Association, who hold a large and valuable tract extending from Indian Bay to Spanish River. It is considered to be the same seam as that worked by the same company at Bridgeport, *i.e.*, the "Phelan." There is, however, so much of a dubious character in this part of the coal-field that further investigation is required to establish

the connection between the two sides of the bay in a satisfactory manner. The seam at Lingan is of the following section :—

| | | | | | | | | | Ft. In. |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----------------|
| Coal | ... | ... | ... | ... | ... | ... | ... | ... | 3 0 |
| Fire-clay | ... | ... | ... | ... | ... | ... | ... | ... | 0 6 |
| Coal | ... | ... | ... | ... | ... | ... | ... | ... | 5 8 |
| | | | | | | | | | <hr/> 9 2 <hr/> |

The course of the dip is about N. 35 E., at an angle of 12°. In proceeding northward the band increased to a thickness of eight feet in a distance of 500 yards; the thickness of the top and bottom coal being very little altered. A recent boring has proved that the band is again becoming thinner. This is mentioned as it may have some bearing on the strangely varied section of the strata and seams exposed in the cliff on the southern side of Spanish river, which is hereafter referred to.

Beneath the Lingan seam others have been found at various points along the north shore of Indian Bay and Lingan Basin. One of these, about 300 feet below the Lingan seam, is four feet thick; and beneath it, 800 feet, there is another two feet thick. This is underlaid by one six feet thick, and by another still lower, consisting of five feet eight inches of coal separated by a band of shale three feet thick; the thickness of the intervening strata has not yet been ascertained. The crop of the last named seam is about three miles to the west of the colliery. It has a dip nearly due east at angle of 10°.

The lowest seam in position that has been opened in the neighbourhood of Lingan is at the Gardener Colliery, distant from the Lingan mine in a south-west direction about $3\frac{1}{4}$ miles. This seam is evidently one of the Bridgeport or Glace Bay series, from its conformability with the seams in the former locality; it is five feet in thickness, and dips S. 65° E. It is supposed to underlie the "Ross" seam nine hundred feet.

The thickness of the strata between the coal beds which, from the order of their succession in proceeding towards Low Point, overlie the Lingan seam, has not been accurately ascertained. The beds appear in the cliffs to be conformable in position with that seam. The first in ascending order is five feet thick, and is separated from it by about 330 feet of strata. At Davy's Head there is another eight feet thick, and one near the Barasois three feet thick. On the north side of the pond at this place the General Mining Association have opened a fine seam of coal six feet in thickness; it is overlaid by a bed of fire-clay two feet thick, above which there is coal two feet eight inches thick. This seam dips

nearly due north at an angle of 10° . Further north, and near to Low Point, another seam four feet thick is exposed in the cliff. Some of these seams have been opened a short distance back from the shore by the occupiers of the land; these openings and the cliff exposures are at present the only guide to the range of the beds and their connection with the series next to be described.

Between Low Point and the south bar of Sydney harbour there is a great alteration in the position of the strata; they bend round to the west, and have a largely-increased angle of dip. In some places it is 45° , and nearly due north in direction. The crops of the seams are in consequence much closer together. Eleven seams of coal are here distinctly recognisable in a distance at right angles to the strike of about a mile. Their relative position is stated by Dr. Dawson to be as in the following section, beginning with the uppermost, which is the same seam as that above referred to, near Low Point:—

| | | | | | | | | | | Ft. In. |
|-------|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|---------|
| No. 1 | Coal | ... | ... | ... | ... | ... | ... | ... | ... | 4 0 |
| | Sandstone and Shale | ... | ... | ... | ... | ... | ... | ... | ... | 400 0 |
| | { Coal and Shale | ... | ... | ... | ... | ... | ... | ... | ... | 1 3 |
| | { Coal | ... | ... | ... | ... | ... | ... | ... | ... | 1 0 |
| | { Shale | ... | ... | ... | ... | ... | ... | ... | ... | 1 7 |
| 2. | { Coal | ... | ... | ... | ... | ... | ... | ... | ... | 1 0 |
| | { Shaly Band | ... | ... | ... | ... | ... | ... | ... | ... | 0 4 |
| | { Coal | ... | ... | ... | ... | ... | ... | ... | ... | 3 0 |
| | { Shaly Band | ... | ... | ... | ... | ... | ... | ... | ... | 1 2 |
| | { Coal | ... | ... | ... | ... | ... | ... | ... | ... | 4 0 |
| | Sandstone and Shale | ... | ... | ... | ... | ... | ... | ... | ... | 200 0 |
| 3. | Coal | ... | ... | ... | ... | ... | ... | ... | ... | 4 4 |
| | Sandstone and Shale | ... | ... | ... | ... | ... | ... | ... | ... | 400 0 |
| 4. | Coal | ... | ... | ... | ... | ... | ... | ... | ... | 6 7 |
| | Sandstone and Shale | ... | ... | ... | ... | ... | ... | ... | ... | 575 0 |
| 5. | Coal | ... | ... | ... | ... | ... | ... | ... | ... | 5 0 |
| | Sandstone and Shale | ... | ... | ... | ... | ... | ... | ... | ... | 1000 0 |
| 6. | Coal | ... | ... | ... | ... | ... | ... | ... | ... | 6 0 |

In addition to the above, there are between numbers 3 and 4, two seams, 2 feet and 1 foot 6 inches thick, and between numbers 4 and 5, two others, 3 feet and 4 feet thick; and, again, between 5 and 6, one 2 feet thick. In the distance named there are, therefore, eleven seams of coal, of an aggregate thickness of about 50 feet. The variation in the dips of these beds of coal is indicative of the peculiarity of their position in this locality: thus, whilst number 1 inclines northward at an angle of 10° , number 2 plunges in the same direction at an angle of 38° , number 4 increases to 40° , and number 6 subsides to 30° . An interesting

starting point is furnished by this section, from which to trace the seams both to the north and to the south, and to fix the true geological position of the beds in the different districts. The data for this purpose, however, are still wanting, as, with the exception above-mentioned, the country is entirely unexplored between the coast line and the head of Lingan Basin. The area included in this space is held by the General Mining Association, and consists of about 13 square miles; it extends from Indian Bay and Lingan Basin to the southern shore of Spanish River, and from the eastern shore between these, inland, a distance of $2\frac{1}{4}$ miles. The only mining areas in this locality available to others are, therefore, those covered by the sea, and it is at the northern end of this tract that the first submarine operations in the province have been begun. The Ross seam, number 4 in the section, has been opened at the Victoria Colliery. The crop of the seam is near the edge of the cliff, and access to the sea area is obtained by a slope starting in the crop; and as the dip of the seam is at an angle of 40° , the strata between the bed of the sea and the seam rapidly thicken.

Dr. Dawson is of opinion, that in the above series of beds are represented all the seams in the Cow Bay and Glace Bay districts, and also those on the northern side of Spanish river. Some of them are probably much altered in character. A division of the Lingan seam has been noticed, and it is not improbable that the overlying coal at the Barasois is still further separated from the lower seam by a thickening of the intervening fire clay or other beds. If the relationship suggested be correct, there is a remarkable instance of the altered form of a seam in the "Paint" seam, number 2 in the section, which is supposed to be the representative of the Phelan seam. It will be remembered, that this is considered to be the same as the Lingan seam; the connection therefore, is not so remote as it would be if the comparison were made between the sections at Caledonia or Schooner Pond and Victoria. At Lingan one of the sections is—

| | | | | | | | | | | Ft. In. |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|---------|
| Coal | ... | ... | ... | ... | ... | ... | ... | ... | ... | 3 0 |
| Fire clay | ... | ... | ... | ... | ... | ... | ... | ... | ... | 8 0 |
| Coal | ... | ... | ... | ... | ... | ... | ... | ... | ... | 5 5 |

The section at the Victoria mine is so entirely different that the question of identity may readily arise.

A series of accurate measurements, and a careful examination and comparison of the strata, will alone enable the connection of the seams in the different localities on the south side of Sydney Harbour to be

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| | | | | | | | Ft. | In. |
|---|-----|-----|-----|-----|-----|-----|-----|---------|
| Under clay | ... | ... | ... | ... | ... | ... | 3 | 0 |
| Shale and sandstone | ... | ... | ... | ... | ... | ... | 103 | 10 |
| Coal | ... | ... | ... | ... | ... | ... | 1 | 4 |
| Shale | ... | ... | ... | ... | ... | ... | 0 | 4 |
| Do. and coal | ... | ... | ... | ... | ... | ... | 0 | 5 |
| | | | | | | | — | 2 1 |
| Under clay | ... | ... | ... | ... | ... | ... | 0 | 5 |
| Shale | ... | ... | ... | ... | ... | ... | 2 | 0 |
| Coal | ... | ... | ... | ... | ... | ... | 0 | 4 |
| Under clay | ... | ... | ... | ... | ... | ... | 5 | 0 |
| Shales | ... | ... | ... | ... | ... | ... | 16 | 6 |
| Coal | ... | ... | ... | ... | ... | ... | 0 | 3 |
| Under clay | ... | ... | ... | ... | ... | ... | 1 | 11 |
| Shale and sandstone | ... | ... | ... | ... | ... | ... | 161 | 9 |
| Coal | ... | ... | ... | ... | ... | ... | 0 | 4 |
| Under clay | ... | ... | ... | ... | ... | ... | 4 | 0 |
| Shale and sandstone | ... | ... | ... | ... | ... | ... | 174 | 9½ |
| Coal—Main seam | ... | ... | ... | ... | ... | ... | 6 | 0 |
| Under clay | ... | ... | ... | ... | ... | ... | 8 | 0 |
| Shale and sandstone | ... | ... | ... | ... | ... | ... | 35 | 1 |
| Coal | ... | ... | ... | ... | ... | ... | 0 | 9 |
| Under clay | ... | ... | ... | ... | ... | ... | 1 | 0 |
| Shales | ... | ... | ... | ... | ... | ... | 11 | 1 |
| Coal | ... | ... | ... | ... | ... | ... | 0 | 4 |
| Under clay | ... | ... | ... | ... | ... | ... | 2 | 3 |
| Sandstones, shales, with limestone and conglomerate beds... | | | | | | | 128 | 8 |
| Coal | ... | ... | ... | ... | ... | ... | 0 | 2 |
| Shale | ... | ... | ... | ... | ... | ... | 0 | 1 |
| Coal | ... | ... | ... | ... | ... | ... | 0 | 3 |
| Shale | ... | ... | ... | ... | ... | ... | 0 | 2 |
| Coal | ... | ... | ... | ... | ... | ... | 0 | 3 |
| | | | | | | | — | 0 11 |
| Under clay | ... | ... | ... | ... | ... | ... | 3 | 0 |
| Shales and ironstone | ... | ... | ... | ... | ... | ... | 73 | 9 |
| Coal | ... | ... | ... | ... | ... | ... | 0 | 4 |
| Under clay | ... | ... | ... | ... | ... | ... | 5 | 6 |
| Sandstones and shales | ... | ... | ... | ... | ... | ... | 40 | 6 |
| Coal | ... | ... | ... | ... | ... | ... | 0 | 5 |
| Shale | ... | ... | ... | ... | ... | ... | 0 | 2 |
| Coal | ... | ... | ... | ... | ... | ... | 0 | 1 |
| | | | | | | | — | 0 8 |
| Under clay | ... | ... | ... | ... | ... | ... | 4 | 0 |
| Sandstones and shales | ... | ... | ... | ... | ... | ... | 22 | 10 |
| Coal | ... | ... | ... | ... | ... | ... | 1 | 3 |
| Under clay | ... | ... | ... | ... | ... | ... | 3 | 1 |
| Red and brown shales and sandstones | | | | | ... | ... | 117 | 3 |
| Coal—Indian Cove seam | ... | ... | ... | ... | ... | ... | 4 | 8 |

THE COAL-FIELDS OF NOVA SCOTIA.

| | | | | | | | | Ft. | In. |
|-----------------------|-----|------------|-----|-----|-----|-----|-----|-----|-----|
| Under clay | ... | ... | ... | ... | ... | ... | ... | 2 | 3 |
| Sandstones and shales | ... | ... | ... | ... | ... | ... | ... | 59 | 6 |
| Coal | ... | ... | ... | ... | ... | ... | ... | 0 | 11 |
| Under clay | ... | ... | ... | ... | ... | ... | ... | 3 | 1 |
| Shales and ironstone | ... | ... | ... | ... | ... | ... | ... | 18 | 10 |
| Coal | ... | ... | ... | ... | ... | ... | ... | 1 | 4 |
| Under clay | ... | ... | ... | ... | ... | ... | ... | 5 | 10 |
| Sandstone and shales | ... | ... | ... | ... | ... | ... | ... | 15 | 0 |
| Coal | ... | ... | ... | ... | ... | ... | ... | 0 | 7 |
| Under clay | ... | ... | ... | ... | ... | ... | ... | 8 | 11 |
| Coal | ... | ... | ... | ... | ... | ... | ... | 0 | 2 |
| Under clay and shale | ... | ... | ... | ... | ... | ... | ... | 12 | 6 |
| Coal | ... | ... | ... | ... | ... | ... | ... | 0 | 2 |
| Under clay | ... | ... | ... | ... | ... | ... | ... | 6 | 0 |
| Sandstone and shale | ... | ... | ... | ... | ... | ... | ... | 68 | 9 |
| Coal | ... | ... | ... | ... | ... | ... | 0 | 1 | |
| Shale | ... | ... | ... | ... | ... | ... | 0 | 3 | |
| Coal | ... | ... | ... | ... | ... | ... | 0 | 2 | |
| Shale | ... | ... | ... | ... | ... | ... | 0 | 2 | |
| Coal | ... | ... | ... | ... | ... | ... | 0 | 2 | |
| | | | | | | | — | 0 | 10 |
| Under clay | ... | ... | ... | ... | ... | ... | ... | 1 | 0 |
| Coal | ... | ... | ... | ... | ... | ... | ... | 0 | 0½ |
| Under clay | ... | ... | ... | ... | ... | ... | ... | 0 | 8 |
| Soft blue clay | ... | ... | ... | ... | ... | ... | ... | 0 | 2 |
| Coal | ... | Stony seam | ... | ... | ... | ... | 1 | 2 | |
| Shale | ... | | ... | ... | ... | ... | 0 | 2 | |
| Blue clay | ... | | ... | ... | ... | ... | 0 | 2 | |
| Coal | ... | | ... | ... | ... | ... | 1 | 3 | |
| Shale | ... | | ... | ... | ... | ... | 0 | 3 | |
| Coal | ... | | ... | ... | ... | ... | 0 | 2 | |
| | | | | | | | — | 3 | 2 |
| Under clay | ... | ... | ... | ... | ... | ... | ... | 1 | 0 |
| Shale | ... | ... | ... | ... | ... | ... | ... | 0 | 11 |
| Coal | ... | ... | ... | ... | ... | ... | 0 | 2 | |
| Shale | ... | ... | ... | ... | ... | ... | 0 | 1 | |
| Coal | ... | ... | ... | ... | ... | ... | 0 | 1 | |
| Shale | ... | ... | ... | ... | ... | ... | 0 | 6 | |
| Coal | ... | ... | ... | ... | ... | ... | 0 | 2 | |
| | | | | | | | — | 1 | 0 |
| Sandstone and shale | ... | ... | ... | ... | ... | ... | ... | 65 | 2 |
| Coal | ... | ... | ... | ... | ... | ... | ... | 1 | 0 |
| Under clay and shale | ... | ... | ... | ... | ... | ... | ... | 2 | 9 |
| Coal | ... | ... | ... | ... | ... | ... | ... | 0 | 1 |
| Sandstone and shale | ... | ... | ... | ... | ... | ... | ... | 69 | 7 |

This section embraces a distance of nearly 3 miles, and a depth of

strata of 1860 feet; and although there are in the entire series upwards of thirty beds of coal, only four of them are workable, viz. :—the Cranberry Head, the Lloyd's Cove, the Main, and the Indian Cove seams. The Lloyd's Cove seam underlies the Cranberry Head 280 feet, the Main seam is at a further depth of 728 feet, and the Indian Cove below it 460 feet. They dip N. 60 E., at an angle of 7°. The main seam has been principally worked; it averages six feet in thickness, and is a remarkably clean and uniform bed of coal, being undisturbed by faults or irregularities of any moment. For domestic purposes, it bears a high and well deserved reputation throughout the provinces, and is also largely exported to Newfoundland and Prince Edward's Island. The Lloyd's Cove and the Indian Cove seams have also been largely worked; the former contains some bands of softish grey shale, which, with other impurities, render it a troublesome seam to work; it is of the following section :—

| | | | | | | | | | Ft. | In. |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Coal | ... | ... | ... | ... | ... | ... | ... | ... | 2 | 1 |
| Soft band | ... | ... | ... | ... | ... | ... | ... | ... | 0 | 1½ |
| Coal | ... | ... | ... | ... | ... | ... | ... | ... | 0 | 5½ |
| Band | ... | ... | ... | ... | ... | ... | ... | ... | 0 | 1 |
| Coal | ... | ... | ... | ... | ... | ... | ... | ... | 3 | 6½ |
| | | | | | | | | | 6 | 3½ |

The connection of these seams with those on the opposite shore, between Low Point and the South Bar, is an object of much interest to the holders of areas along that shore; and in a geological point of view is one of much importance. It is evident the measures are much disturbed, and it is probable the line of disturbance is indicated by the course of the harbour. The abruptness of the change in the direction of the strike, and in the angle of dip, and the crowding together of the several beds on the south side, are in marked contrast with the unbroken series on the north side of the harbour, and render the identification of the seams very difficult. Whether or no this may be established hereafter, it is sufficient for the purpose of this paper to consider the northern shore a fresh starting point, from which to continue the description of this portion of the coal-field.

Between this shore and the northern side of Boulardarie Island, a distance of 8 miles, the measures range in a north-westerly direction, though not in an uninterrupted course as regards the continuity of the seams. With the exception of an opening made by the General Mining Association at Cox Hill, 2¼ miles west of the Queen Pit, on the Main seam, the seams are but partially explored between Spanish River and the

Little Bras d'Or, a narrow winding and exceedingly picturesque opening, between the Atlantic and a large inland sea known as the Bras d'Or Lake. On each side of this passage the seams appear in the cliffs, and are entered by adits; the transit of the coal from the workings to the ship side being thus very economically effected. One of the seams has been opened at the Collins Mine, on the south-east side; it is supposed to be the Indian Cove seam. It has also been sunk to by the Association, a short distance back from the shore. The sections at these places are, however, a little different, and are also at variance with that at the No. 3 Pit on the Company's area, and near Sydney Harbour, and with one at an opening about midway between the harbour and the Bras d'Or. These sections are as follows:—

| No. 3 Pit. | | Ingraham. | | Collins. | | Association to dip. | |
|----------------|-----------------|-----------|-----------------|----------|-------------------|---------------------|------------------|
| | Ft. In. | | Ft. In. | | Ft. In. | | Ft. In. |
| Coal and shale | 0 3 | Coal | 1 1 | Top coal | 2 7½ | Coal | 2 4 |
| Coal... | 0 4 | Band | 0 3½ | Bottom | 2 4 | Band | 0 4½ |
| Grey band | 0 2 | Coal | 0 5½ | | | Coal | 2 7 |
| Coal... | 3 10 | Band | 0 2½ | | | | |
| | | Coal | 1 11½ | | | | |
| | <hr/> 4 7 <hr/> | | <hr/> 4 0 <hr/> | | <hr/> 4 11½ <hr/> | | <hr/> 5 3½ <hr/> |

Whilst a change, such as is here exhibited, is not an unusual feature in extensive mining districts, there appear to be in this locality alterations in the seams of a general character, and not confined to one seam only. A similar irregularity in the thickness of the main seam was found to exist at the Cox Hill Pit, where it is only 3 feet 7 inches thick near the crop. The continuity of the seams appears, nevertheless, to be undisturbed to any extent as far as the Little Bras d'Or. The gap which forms this passage is, however, on the line of a large fault, the existence of which has recently been ascertained by Professor Hind during an examination of the measures in this locality. It is an upthrow to the north of about 400 feet. By this fault the crops of the seams are removed to the north upwards of a mile, and a large extent of the lower strata is exposed on each side of Boulardarie Island. The Lloyd's Cove, the Main, and the Indian Cove seams are well identified on the west side of the entrance, and their course has also been traced across the island to the opposite side, where, with a trending of the strike to the north, they disappear in the sea. On this shore several other beds of coal of a workable size are exposed in the cliff between Point Aceni and the Great Bras d'Or entrance. These beds have not yet been traced across the island to the Little Bras d'Or, but there is little reason to

doubt the regularity of the measures between the two entrances. One of the seams has been opened at the Matheson Colliery, opposite to the Collins mine. It is 3 feet thick and is overlaid by 15 inches of excellent fire clay. The dip is to the north-east at an angle of 8° .

An interesting field of enquiry is embraced in the tract of country extending from Sydney Harbour to the Great Bras d'Or. The poverty of the section, with respect to workable seams, from Cranberry Head up the north-west arm of the harbour, is in striking contrast both with the opposite shore and with the western side of Boulardarie Island; and a reconciliation of the differences cannot fail to elicit some interesting geological circumstances.

A brief notice of an isolated patch of carboniferous strata remains to complete the description of the Cape Breton coal-field. On the west side of the Great Bras d'Or seams have been opened at the New Campbellton Colliery, the connection of which with those on the opposite shore of the island is somewhat peculiar. The beds on that shore, as before stated, have a trending of the strike northwards, which, it will be seen on reference to the map, leads to a very different point to that which is now referred to. The portion of the coal measures in which seams have been opened, at the New Campbellton Colliery, is situated on the eastern flank and near the extremity of a range of high land, which terminates a long neck of the main land stretching between the Bras d'Or and an inlet of the sea called St. Ann's Bay. A ridge of syenite running in an east and west direction here interrupts the extension of the beds and thus forms their western boundary. Although the space occupied by the measures is but of small extent their true position is not yet fully established. The course of the strike on the shore opposite Boulardarie, and in a seam opened a short distance to the north, seem to indicate a somewhat rapid bending round of the beds, and to give them a basin shape similar to that at Cow Bay. This seam is of the following section :—

| | | | | | | | | | Ft. | In. |
|---------------|-----|-----|-----|-----|-----|-----|-----|-----|-------|-------|
| Coal (coarse) | ... | ... | ... | ... | ... | ... | ... | ... | 0 | 4 |
| Coal | ... | ... | ... | ... | ... | ... | ... | ... | 2 | 9 |
| Soft posting | ... | ... | ... | ... | ... | ... | ... | ... | 0 | 1 |
| Coal | ... | ... | ... | ... | ... | ... | ... | ... | 1 | 3 |
| | | | | | | | | | <hr/> | <hr/> |
| | | | | | | | | | 4 | 5 |

It dips to the east at an angle of 12° . About three-quarters of a mile further north, the beds are thrown up against the side of the mountain into a nearly vertical position. Two seams have been opened by an

adit driven at right angles to the strike. The first or uppermost in the order of deposition is 4 feet thick, the next is 6 feet, a thickness of strata of 36 feet separating them. Between these seams and the crop of the other seam no sufficient examination has yet been made to enable the relation of the beds to be defined. There are indications, however, which make it probable that they sweep round from the Bras d'Or as stated, and are turned to the eastward and thrown up by the syenitic ridge. The relation of the vertical seams to that in the more normal position is still undetermined, and the difficulty is increased by the hitherto unsuccessful attempts to find another seam above or below it that might assist the identification.

The relative position of the beds on each side of the Great Bras d'Or is very similar to the form in which they appear at Sydney Harbour and Indian Bay, Lingan; and there is, doubtless, a like cause for the change in their course. Interruptions by anticlinals or dislocations on a large scale sufficiently account for many of these changes; and the position of these disturbances is generally indicated by a high and broken ridge as at Cow Bay, or by wide and deep bays and water channels as at Lingan, Sydney, and Little Bras d'Or.

In the Cape Breton coal-field there is little diversity in the character of the seams; they are all of the bituminous class, and, except for gas, no special adaptability is yet attached to any of them. The Main seam of the Sydney mines has, however, a deservedly high reputation for domestic use, for which it is sold almost entirely. It is a clean bright coal, with a cubical fracture; it works large, gives out much heat, and leaves a small quantity of reddish ash. An analysis by Professor How, in 1861, gave

| | | | | | | | |
|-------------------|-----|-----|-----|-----|-----|-----|--------|
| Volatile matter | ... | ... | ... | ... | ... | ... | 31.87 |
| Fixed carbon | ... | ... | ... | ... | ... | ... | 64.59 |
| Ash | ... | ... | ... | ... | ... | ... | 3.54 |
| | | | | | | | <hr/> |
| | | | | | | | 100.00 |
| | | | | | | | <hr/> |
| Theo. evap. power | ... | ... | ... | ... | ... | ... | 8.87 |

The beds on the opposite shore of the harbour near Low Point have been examined by Dr. Dawson, and analyses of the principal seams have been made by him with the following result:—

| | | | | | | | | |
|-----------------|-----|-----|-----|-----|-----|-------|-------|-------|
| | | | | | | 1 | 2 | 3 |
| Volatile matter | ... | ... | ... | ... | ... | 39. | 38.8 | 35.4 |
| Fixed carbon | ... | ... | ... | ... | ... | 59. | 59.4 | 63.0 |
| Ash | ... | ... | ... | ... | ... | 2. | 1.8 | 1.6 |
| | | | | | | <hr/> | <hr/> | <hr/> |
| | | | | | | 100. | 100. | 100. |
| | | | | | | <hr/> | <hr/> | <hr/> |
| Coke | ... | ... | ... | ... | ... | 61.0 | 61.2 | 64.6 |

| | | | | | 4 (top). | 4 (bottom). | 6. |
|-----------------|-----|-----|-----|-----|--------------|--------------|--------------|
| Volatile matter | ... | ... | ... | ... | 39.6 | 37.8 | 31.4 |
| Fixed carbon | ... | ... | ... | ... | 57.2 | 59.6 | 62.4 |
| Ash .. | ... | ... | ... | ... | 3.2 | 2.6 | 6.2 |
| | | | | | <u>100.0</u> | <u>100.0</u> | <u>100.0</u> |
| Coke... | ... | ... | ... | ... | 61.3 | | 68.6 |

The analyses are numbered in accordance with the order in which the seams are given in the section, page 40.

The seams between Lingan and Cow Bay are very similar in their characteristics, and need no special description. The coal is exported principally to the United States for gas-making, and although they differ in their produce, generally speaking they are a fine and valuable series of beds. The subjoined analyses of the coal from the seams at Glace Bay and Cow Bay will show their respective compositions:—

HUB SEAM, LITTLE GLACE BAY.

| | | | | | | | |
|--------------------|-----|-----|-----|-----|-----|-----|---------------|
| Volatile matter | ... | ... | ... | ... | ... | ... | 36.54 |
| Fixed Carbon | ... | ... | ... | ... | ... | ... | 62.53 |
| Ash | ... | ... | ... | ... | ... | ... | 9.3 |
| | | | | | | | <u>100.00</u> |
| Theor. evap. power | ... | ... | ... | ... | ... | ... | 8.59 |

Both the Hub and the Harbour seam have been tested for raising steam in one of H.M. ships, and are reported "to light up quickly, raise steam fast, burn well and clearly, and generate steam well." The Hub seam is an excellent gas-coal, and is much used in the States for that purpose. At Halifax it has been found to yield 8,500 cubic feet per ton of 16 candle gas.

A series of assays of portions of the Phelan seam at Caledonia Colliery gave the following average:—

| | | | | | | | |
|-----------------|-----|-----|-----|-----|-----|-----|---------------|
| Volatile matter | ... | ... | ... | ... | ... | ... | 33.02 |
| Fixed carbon | ... | ... | ... | ... | ... | ... | 57.86 |
| Ash | ... | ... | ... | ... | ... | ... | 9.62 |
| | | | | | | | <u>100.00</u> |
| Coke | ... | ... | ... | ... | ... | ... | 69.2 |
| Spec. gravity | ... | ... | ... | ... | ... | ... | 1.32 |

The Block House seam is largely worked for gas purposes, for which it bears a high character. For raising steam it has also given satisfactory results. Mixed with Welsh coal the consumption was found to be 12 per cent. less than when using Welsh alone.

The McAulay seam at the Gowrie Colliery is also an excellent coal

for general purposes, and has been found to possess good steam-producing properties. The following analyses were made in 1863.

| | | | | | | | 1st and 2nd band. | 2nd band. |
|--------------------------|-----|-----|-----|-----|-----|-----|----------------------|--------------|
| Moisture | ... | ... | ... | ... | ... | ... | 1·80 | 1·46 |
| Hydrocarbonaceous matter | ... | ... | ... | ... | ... | ... | 27·08 | 37·27 |
| Sulphur | ... | ... | ... | ... | ... | ... | 3·42 | 1·27 |
| Coke | ... | ... | ... | ... | ... | ... | 67·70 | 60· |
| | | | | | | | <hr/> 100·00 | <hr/> 100·00 |
| Ash | ... | ... | ... | ... | ... | ... | 7·25 | 4·15 |
| Theor. evap. power | ... | ... | ... | ... | ... | ... | 8·53 | |
| Spec. gravity | ... | ... | ... | ... | ... | ... | | 1·33 |

The system of working practised is the same as in the other coal-fields, viz., the bord and pillar. With the exception of the Sydney Mines all the seams are entered by slopes from the crop, and the mode of working appears to have been adopted with a view to the removal of as much of the coal as possible in the first working. The pillars next the crop are, therefore, usually very small. In few cases has an attempt been made to work the pillars, though in these they have been successfully done. An enlarged scale of pillage is, however, being adopted, and the pursuit of a more systematic course of working becoming general. The vertical seams at the New Cambellton Colliery are worked on the same principle as the horizontal beds, the bords being driven upwards in a series of steps, and the coal taken through holings at short intervals between each bord to a spout, which has a slide at the bottom. The tubs are put into a siding off the horse road, under the spout, and the contents run into them.

The crops of the seams being so near the sea-board, most of the collieries are situated near those parts of the coast to which vessels can have access. The harbour accommodation between Miré and Sydney is not, however, so good as in other localities. The bays are exposed to gales from the north-east, and are often rendered unsafe. There is, however, a very fine and commodious harbour at Sydney, but it is inaccessible at present, owing to their being no railway to connect it with the mines. An attempt was made a few years ago to have one constructed at the joint expense of the mine owners, which, unfortunately, was unsuccessful. The consequence has been, that artificial harbours have been made at several places at great cost, for the private use of some of the mines, and the other collieries have been seriously limited in their operations by the want of similar facilities. At Cow Bay, the Block House and the Gowrie Mines have each their own shipping

place within a mile of each other. The latter is protected by an extensive breakwater, erected on the north-east side of the shipping berths; the enclosed space between them affording shelter to vessels in time of need. At Block House the coal is brought out of the mine by an adit on a level with the wharf, and as the seam is remarkably clean, it is taken direct from the face to the ship's side. The Caledonia Company have provided themselves with a harbour, by cutting through a sand bar which runs out from the south side of Big Glace Bay, and by erecting piers for the protection of the entrance into the water behind this bar; a short line of railway connects the harbour with the colliery. Neither the Clyde nor the Schooner Pond Mines have at present any efficient means of shipping their coal. At Little Glace Bay a small but safe harbour has been formed by the Glace Bay Company; a small and almost dry creek having at a comparatively little cost been converted into an excellent shipping place. The Lingan and International Collieries are also dependent on their own resources for putting their coal on board of ship. At the former considerable expense has been incurred in making and maintaining a shipping place for its exclusive use; and at the latter the coal is taken off in large boats called "scows," and put on board the vessel at anchor in the exposed roadstead. This serious impediment to an extension of the mining capabilities of this district, has, of late, again received attention, and a railway is in course of construction between the mine and Sydney Harbour. The produce of the Sydney Mines is shipped at North Sydney. Extensive accommodation is here provided by the General Mining Association, by whom alone coal is shipped at this part of the harbour.

All these harbours are closed from two to three months during the winter by ice, and navigation is sometimes impeded a longer period. During that time the mines are continued at work and the coal is stored on the surface, as at the other mining districts.

The mode of opening the mines is by slope from the crop as already described. In some cases shafts have been sunk to the dip of the first workings; more, however, with a view to increase the productive powers than from a preference of a shaft to a slope. The latter is, in many cases, an inexpensive method of commencing operations, but it is certainly not the most judicious means that can be adopted. The facility with which it enables operations to be begun, is a great temptation to work the coal much too near the crop, and the consequence is, the surface water has access to the mine; the coal, too, is generally neither so strong nor so clean. One of the greatest evils connected with this hasty system of

opening is, however, the indifference that has prevailed respecting the position of the seam throughout the areas. Instead of carefully ascertaining this by boring, it is taken for granted that it lies in an undisturbed state, and that subsequent operations will present no more difficulty than has hitherto been experienced. The Victoria Colliery, in Cumberland County, is not a solitary instance of the inconvenience and expense caused by the want of a little knowledge of the kind referred to.

The mode of payment to the miners varies considerably in this district. At some of the collieries the price is per cubic yard, at others per tub, at one of them it is per ton, and at another per lineal yard. The rate in the former case is from 27 cents to 32 cents, or 1s. 1d. to 1s. 3d. per cubic yard; where it is by the tub at one mine it is 17 cents, or 8d. per tub of 7 cwts. in the bords, and 4s. per yard extra in the level; at another 22 cents, or 10½d. per tub of 12 cwts. is paid in the bords, and 3s. 2d. per yard extra in the levels. The price per ton at the colliery where that system is adopted, is 46 cents, or 1s. 10d. Every tub is weighed as it comes to bank, and the arrangement is considered very satisfactory.

The price of the coal at the mines is from 7s. to 9s. per ton. A large proportion of the shipments is to the States, the remainder being used in the province and the adjoining colonies. Freights to Boston and other ports on the American shore vary from 9s. to 12s.

At many of the collieries the surface erections are simple and inexpensive. A carefulness in screening and cleaning the coal is not yet so generally practised as will in a short time probably become necessary. In a few instances, the appliances for these purposes are of a good type, and the establishments generally are very creditable. The double horizontal cylinder engine is chiefly used for hauling, winding, and pumping. The drum is usually driven by spur gearing; in some cases friction gearing is applied. In one instance it is of the grooved wheel construction, and in another on the bevelled surface principle. At the Albion and Sydney Mines an older style of engine is in use. New winnings are, however, in hand at each of these places, and powerful engines for winding and pumping have been erected.

The coal is conveyed from the mines to the shipping places in wagons or cars, in the size and shape of which there is much diversity. The ordinary chaldron wagon of the North of England is generally used at the Sydney and the Albion Mines. At others there are cars of different shapes, some of which carry two tons, some six tons. Locomotives are used to convey them between the pit and the wharves; or in a suitable

situation the transit is effected by self-acting inclines. One other locality remains to be noticed to complete the circuit of the coal measures, considered only with respect to their capability of being utilized. In the county of Richmond, at the south-west corner of the island, there is a patch of carboniferous rocks in which seams of coal of a workable size have been opened. Some of these appear in the cliffs at the Sea Coal Bay, in Carribon Cove. They are in a vertical position, having a dip to the south-west of 75° , the course of the strike being N. 50° W. The principal seam is upwards of 11 feet thick, inclusive of several bands of shale. The others are 4 feet and $5\frac{1}{2}$ feet in thickness, the latter also including a band of fire clay near the middle of the seam, 15 inches thick. The strata are here much disturbed, and as the operations have been confined entirely to the crop of the seam, little is known of their extent or general shape. At a depth of 63 feet the angle of dip was found to be rapidly diminishing, and it is, therefore, not improbable that they will lie at no great depth in a more convenient form for working.

The coal, according to the following analysis by Dr. Dawson, of a portion of the thick seam, is not of a very high class; an improvement in the quality may, however, be reasonably expected where the seam is in a less disturbed condition and the operations are further removed from the crop.

| | | | | | | | | |
|-----------------|-----|-----|-----|-----|-----|-----|-----|-------------|
| Volatile matter | ... | .. | ... | ... | ... | ... | ... | 25.2 |
| Fixed Carbon | ... | ... | ... | ... | ... | ... | ... | 44.7 |
| Ash | ... | ... | ... | ... | ... | ... | ... | 30.1 |
| | | | | | | | | <hr/> 100.0 |

About $2\frac{1}{2}$ miles to the north-east of Sea Coal Bay seams have been opened at the Richmond Colliery which agree with the above in the course of their strike, but have their dip in the opposite direction. There are two seams 154 feet apart, the lowest in the order of deposition being four feet thick, and the other three feet. They dip to the north-east at an angle of 85° . The quality of the four feet bed appears in an analysis, also by Dr. Dawson, to be superior to the Sea Coal Bay seam:—

| | | | | | | | | |
|-----------------|-----|-----|-----|-----|-----|-----|-----|--------------|
| Volatile matter | ... | ... | ... | ... | ... | ... | ... | 30.25 |
| Fixed carbon | ... | ... | ... | ... | ... | ... | ... | 56.40 |
| Ash | ... | ... | ... | ... | ... | ... | ... | 13.35 |
| | | | | | | | | <hr/> 100.00 |

The similarity of position of these beds to those at Sea Coal Bay, assuming them to be on the opposite sides of an anticlinal, would seem to indicate a former connection; there is so little known, however, of the structure of the measures in localities in which mining operations have

only been carried on a short time, that conjecture on this point has little beyond general features to support it. These vertical seams, when the mines were last in operation, were worked in the following manner. At the Richmond Colliery they were at first opened by a slope driven at a convenient angle in the course of the strike. Subsequently a shaft was sunk between the beds, and level drifts were driven out of it into each seam at intervals of about 40 feet. A lift of coal was then taken off this height by driving a drift 6 feet high in the coal at that depth. When this drift was about 10 yards in length, other 6 feet were taken out above the drift, timber being put in and a scaffold formed next the face as it advanced. Above this, again, another lift was taken in the same manner, each face being kept regularly going. The coal as it was worked fell into the lowermost place, whence it was taken to the shaft. The seam would, thus, if in a horizontal position, appear to have a long wall face, with the roof entirely supported by timber.

The preceding embraces all the coal districts of any importance in the province. The carboniferous formation is spread to a greater or less extent over other localities; the circumstances of geological position are in most cases, however, sufficient to convince the experienced miner of their barrenness, and are such as should elicit an honest avowal to the enquiring speculator of the fruitlessness of operations in many of these places. In some of them, it is by no means improbable that future explorations may truly *bring to light* beds of coal, whose existence is not yet indicated by any external evidence.

The laws which regulate the holding of mining areas have been framed in a liberal spirit, and with a view to encourage the development of the mineral resources of the province.

An exploration license, giving a power to search for minerals, other than gold, over a tract not exceeding five square miles in extent, is granted on payment of 20 dollars, or £4 sterling. This license is for twelve months. At any time before the expiration of the license, the holder may select one square mile, which must be in one block, and must not exceed $2\frac{1}{2}$ miles in length, for the purpose of working the minerals therein; and on application being made, in writing, to the Commissioner of Mines, a license to work is granted for a term of two years from the date of the application, the cost of such license being 50 dollars, or £10 sterling. On the termination of that period the holder is entitled to a lease, provided effective mining operations have been begun and carried on. Before these licenses are issued a bond must be given to the Commissioner, with sufficient sureties, that in the event of entry

being made upon private lands, recompense shall be made for damages. The conditions of the lease are similar to those usually inserted. The lease is for twenty years, with a power of a second and third renewal for a similar period, but not to extend beyond sixty years from the 25th August, 1866, and with a liberty to the Legislature to revise and alter the royalty in or after the year 1886. The royalty at present is 10 cents, or 4½d. per ton of 2240 lbs., up to 250,000 tons, sold in each or any year, and about 3d. per ton on every ton over that quantity. It is payable only on the round coal sold; slack and coal used by agents, workmen, and engines, being exempt. A statement is required quarterly, of all coal worked and sold, and of the expenditure in extending the works; also payment of the royalty incurred. The other conditions of the lease are of the usual character with respect to a proper working of the mine, the right to examine the workings, and books of accounts, surrender of the lease, right of transfer, &c.

Deeming it would be of interest to know the progress of mining in Nova Scotia, a few statements respecting the production and disposal of the coal from 1827 to the end of 1869 are appended. It will be observed that the sales since 1866 have much fallen off. This is due to the abrogation of a reciprocity treaty which existed up to that time between the United States and the British North American Provinces. On the cessation of the treaty a duty of 5s. sterling per ton was imposed by the United States Government, and, as will readily be believed, it almost amounted to a prohibition. A blow of this kind to a merely budding branch of commerce could not fail to check its progress. With all allowance for the obstacle thus opposed to its development, it is, however, much to be regretted that a lack of energy in looking for other markets should have prevailed to an extent that inferred a hopelessness on the part of the proprietors of many of the mines, very unusual in men of business.

Of the mineral wealth of the province generally much might be written. Its extensive range of auriferous rocks, its undeveloped but known beds of iron and other ores, are subjects almost as interesting as that of which the writer has endeavoured to convey some knowledge in this memoir. Much remains to be done to assign the limits of the different coal-fields and to define the peculiarities of the various districts. Although there is not in the province the diversity of quality that characterizes some coal-producing countries, there are variations of character in the seams, the extent of which is yet unknown. If there are no beds of cannel of importance, there are oil shales and seams richly productive of

that article; if there is no anthracite, there is a variety of bituminous and semi-bituminous coal, among which the essentials of a first-class house coal, of a steam, a gas, or a coking coal will, no doubt, hereafter be detected.

Respecting the future of a country so richly endowed with what has become almost a necessity of life, and which is certainly a necessity of the age; possessing also other minerals, the profitable virtue of which is dependent on the abundant and cheap supply of the grosser materials, no fear can arise, no mistrust be excited. And of such a country, with such elements of wealth, such industrial resources, and such an association of circumstances requisite to their full development, it may surely be anticipated that its destiny will be one of great usefulness and of no mean importance in the "land of the west."

STATEMENT OF QUANTITY OF COAL RAISED AND SHIPPED IN THE
PROVINCE OF NOVA SCOTIA FROM THE YEAR 1827 TO THE
YEAR 1869, INCLUSIVE.

| Year. | Tons. | Cwts. | Year. | Tons. | Cwts. |
|----------|---------|-------|----------|-----------|-------|
| 1827 ... | 11,491 | 0 | 1850 ... | 163,725 | 8 |
| 1828 ... | 19,429 | 17 | 1851 ... | 139,976 | 13 |
| 1829 ... | 20,252 | 12 | 1852 ... | 171,821 | 18 |
| 1830 ... | 25,240 | 6 | 1853 ... | 196,935 | 17 |
| 1831 ... | 34,424 | 8 | 1854 ... | 213,250 | 16 |
| 1832 ... | 46,580 | 6 | 1855 ... | 216,338 | 3 |
| 1833 ... | 59,497 | 4 | 1856 ... | 231,934 | 7 |
| 1834 ... | 46,677 | 12 | 1857 ... | 267,808 | 17 |
| 1835 ... | 51,813 | 5 | 1858 ... | 289,618 | 0 |
| 1836 ... | 98,427 | 3 | 1859 ... | 267,496 | 0 |
| 1837 ... | 109,347 | 12 | 1860 ... | 304,129 | 0 |
| 1838 ... | 97,938 | 14 | 1861 ... | 334,545 | 15 |
| 1839 ... | 133,928 | 11 | 1862 ... | 393,631 | 5 |
| 1840 ... | 98,267 | 17 | 1863 ... | 424,425 | 2 |
| 1841 ... | 136,110 | 9 | 1864 ... | 576,934 | 0 |
| 1842 ... | 119,478 | 12 | 1865 ... | 635,586 | 0 |
| 1843 ... | 97,200 | 12 | 1866 ... | 558,519 | 0 |
| 1844 ... | 99,993 | 14 | 1867 ... | 471,185 | 0 |
| 1845 ... | 137,908 | 13 | 1868 ... | 453,624 | 0 |
| 1846 ... | 134,393 | 12 | 1869 ... | 511,794 | 0 |
| 1847 ... | 183,099 | 13 | | | |
| 1848 ... | 170,518 | 1 | | 8,914,254 | 4 |
| 1849 ... | 158,955 | 10 | | | |

1871 - 500,000

1872 - 700,000

1873 - 800,000

STATEMENT SHOWING THE DISTRIBUTION OF THE SALES OF COAL
FROM THE YEAR 1866 TO THE YEAR 1869 INCLUSIVE.

| | Home Consumption. | Neighbouring Colonies. | Other Countries. |
|--------------|----------------------|---------------------------|---------------------|
| 1866. | Tons. | Tons. | Tons. |
| Round | 91,281½ | 95,104½ | 334,206½ |
| Slack | 13,010½ | 12,217½ | 12,699½ |
| | 104,292 | 107,322 | 346,905½ |
| 1867. | | | |
| Round | 88,538½ | 96,238½ | 253,021 |
| Slack | 13,677½ | 9,234 | 100,475½ |
| | 102,216 | 105,472½ | 263,496½ |
| 1868. | | | |
| Round | 97,715½ | 91,376 | 224,466 |
| Slack | 19,914 | 11,439 | 8,714 |
| | 117,629½ | 102,815 | 233,180 |
| 1869. | | | |
| Round | 98,727½ | 114,168½ | 257,729½ |
| Slack | 17,209½ | 14,929 | 9,031 |
| | 115,936½ | 129,097½ | 266,760½ |

STATEMENT OF THE QUANTITY OF COAL RAISED IN EACH COUNTY
IN THE YEARS 1866-67-68-69.

| COUNTY. | 1866. | 1867. | 1868. | 1869. |
|--------------------|----------|----------|----------|----------|
| | Tons. | Tons. | Tons. | Tons. |
| Cumberland | 17,547½ | 13,319 | 11,628 | 15,066 |
| Pictou | 245,548 | 135,821 | 140,430½ | 218,672½ |
| Inverness... .. | 4,044 | 5,813 | 200 | 448 |
| Victoria | 4,639 | 3,642½ | 1,611 | 397 |
| Richmond | | 880 | 38 | |
| Cape Breton | 393,219½ | 358,050 | 308,280½ | 343,448½ |
| Totals | 664,998½ | 517,525½ | 462,188½ | 578,082 |

The PRESIDENT (Mr. E. F. Boyd), in reference to the foregoing paper, observed that they ought to feel very much flattered that a gentleman, who had left this country and had taken such an important position in the mining operations of Nova Scotia, should have taken upon himself the responsibility and trouble of writing such a long and valuable paper, and he thought their best thanks were due to him for his exertions.

A unanimous vote of thanks was accorded Mr. Rutherford.



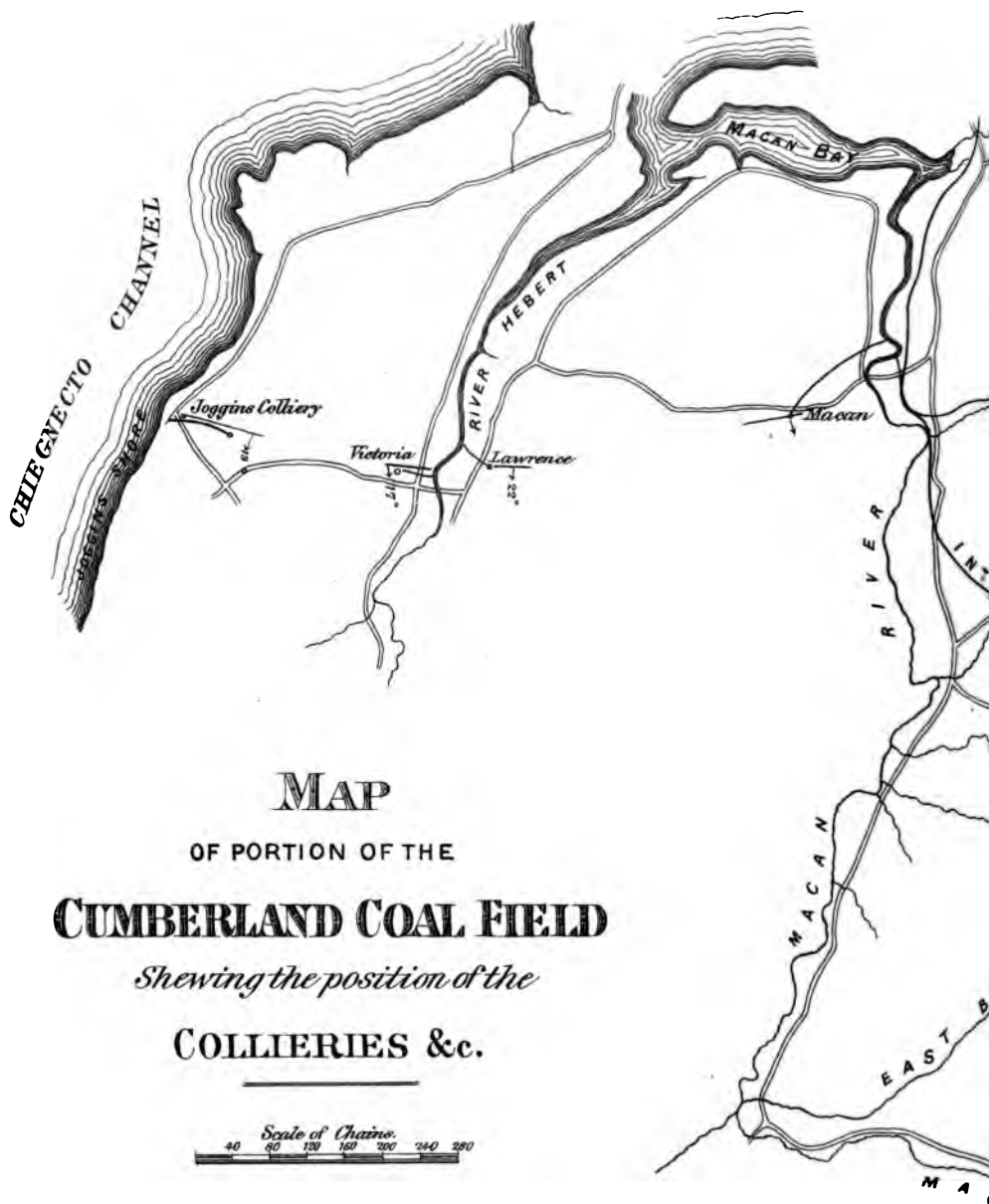


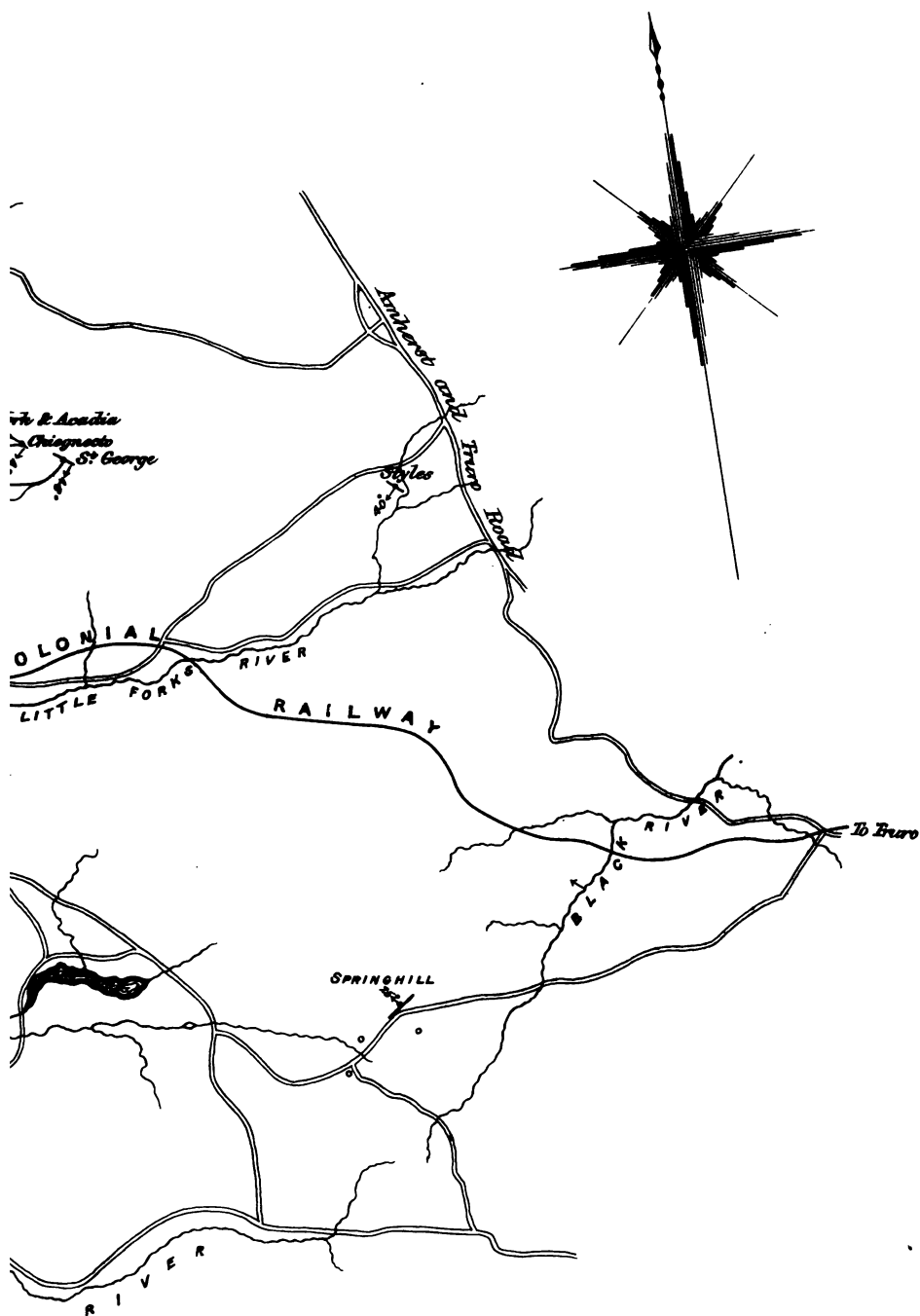


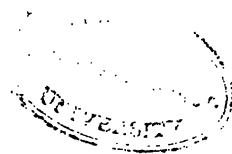
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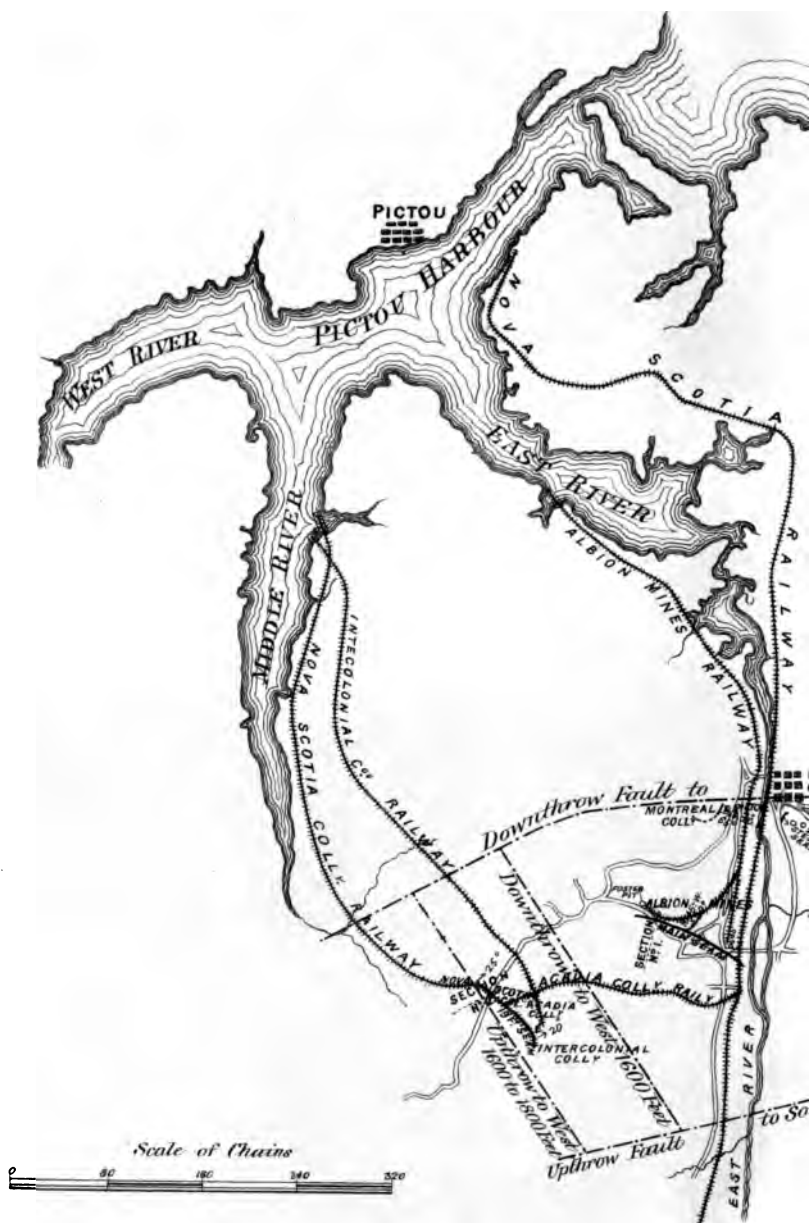
MAP
OF
NOVA SCOTIA
Showing the
CARBONIFEROUS FORMATION
and position of the
COAL FIELDS.













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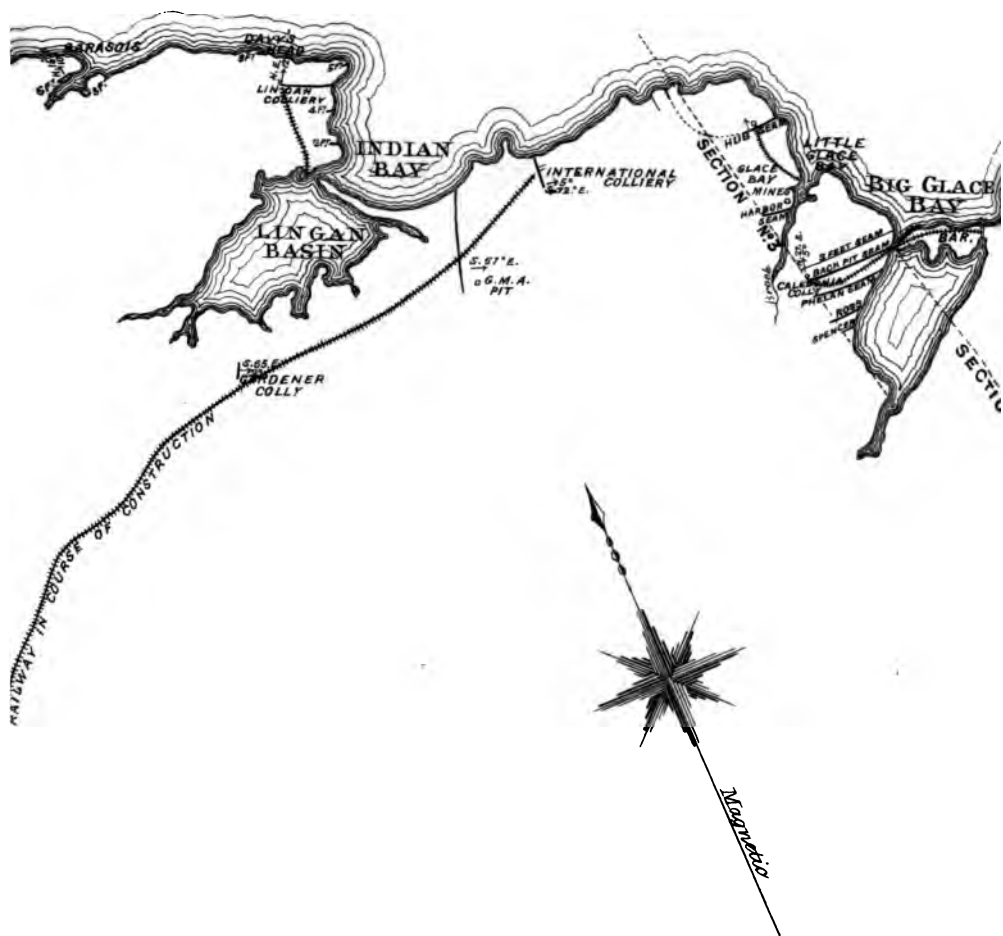
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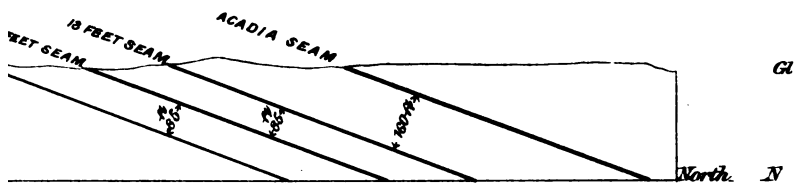
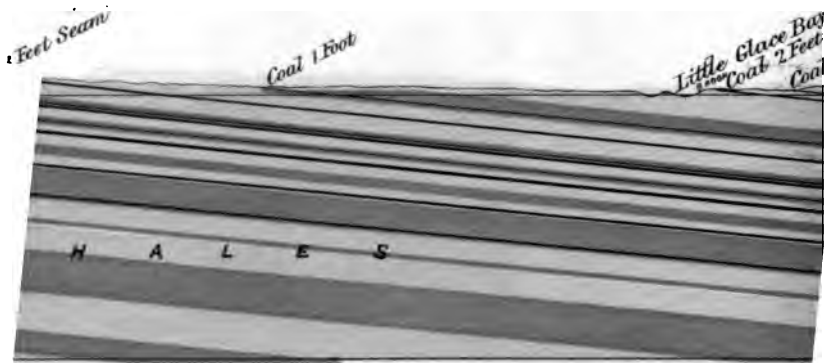
Scale of Chains



Specimens taken from the shore of Indian Bay - the green-spruce harbor & Lingan Bay, and the
 Indian shore & interior mines of the Indian

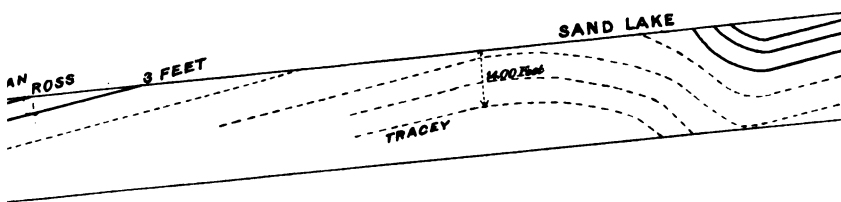
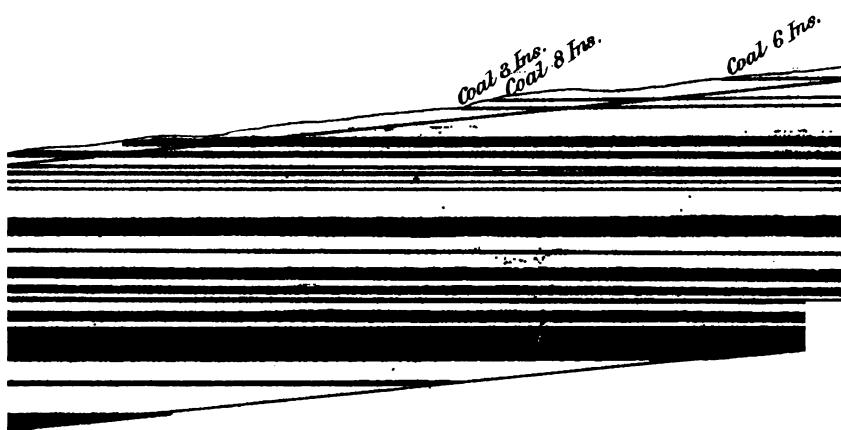
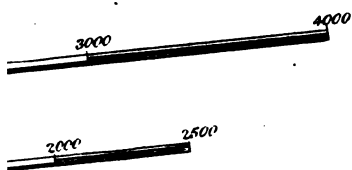
and Stanford.
GIVEN

SECTION N^o.3, GLACE



SECTION N^o.2, PICTOU DISTRICT.

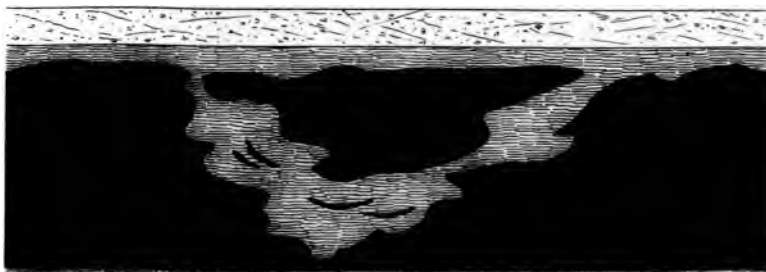
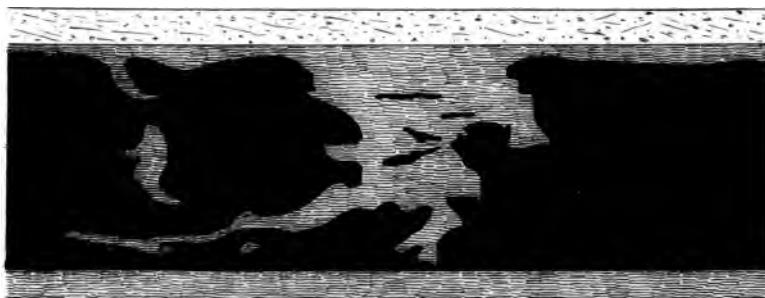
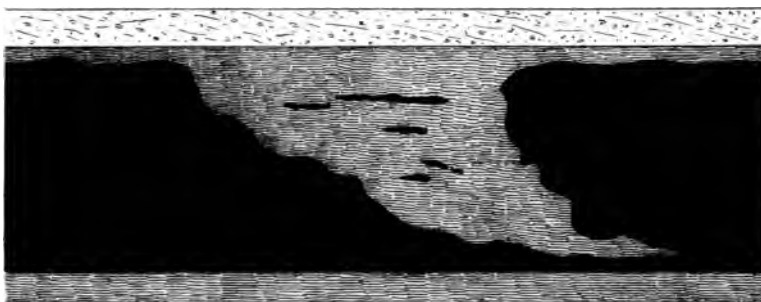
RICT, CAPE BRETON.



SECTION N° 4, COW 1
Showing probable position



SECTIONS SHOWING SHAPE OF MASSES OF
SHALE IN THE BLOCK HOUSE SEAM.



1. The first of these is the fact that the Government has not yet decided whether it will accept the offer of the United States to purchase the island.

553.2 .R975 C.1

The coal-fields of Nova Scotia

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